Research Report

An Exploration of the Policy and Practice of Transdisciplinarity in the IB PYP Programme

Susan M. Drake, Ph. D

Michael J. Savage, Ph. D

Joanne L. Reid

Michelle L. Bernard

Jacqueline Beres

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Graduate and Undergraduate Studies in Education Department
Brock University

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Executive Summary

An Exploration of the Policy and Practice of Transdisciplinarity in the International Baccalaureate (IB) Primary Years Programme (PYP)

The International Baccalaureate (IB) Primary Years Program (PYP) for students aged 3 to 12 years is known for both its rigour and relevance. The purpose of this study was to investigate how PYP teachers, coordinators and administrators conceptualize and apply transdisciplinary approaches to teaching and learning as part of their practice and how they balance disciplinary and transdisciplinary learning. A second purpose was to explore PYP teachers', coordinators' and administrators' lived experiences working in the IB PYP. A deeper understanding of how IB educators are making meaning of, and implementing, the mandated transdisciplinary PYP could facilitate some resolution of the tension between disciplinary and transdisciplinary approaches.

Literature Review

The literature review is set in the context of the call for educational reform in the 21st Century. There is an ongoing global tension between the need for accountability through large-scale testing and the pressing need to create a curriculum that will not only engage students, but will also facilitate the development of generic skills such as communication, problem-solving, technological literacy, creativity, critical thinking and desired values and behaviours. As integrated curriculum is perceived to be a hindrance to the accountability agenda, it is also seen to be a route to generic skills and values and behaviours.

Three obstacles seem to hinder implementation. One, there is no common understanding of what integrated curriculum looks like given a myriad of definitions that theorists have put forth. Two, evidence for the success of integrated approaches has been muddied with anecdotal research, testimonies, how-to descriptions, and a lack of a solid empirical research. Three, there is a general lack of understanding and knowledge of the long and important history of such approaches. This literature review addresses these three issues. The views of several theorists on definitions are offered. The relationship of disciplinarity and transdisciplinarity is explored. A history of integrated curriculum beginning with John Dewy and the Eight Year Study is presented in the context of evidence of the effectiveness of such approaches. Effectiveness is explored from the lens of academic achievement, student engagement and affective responses. Robust research is offered from individual case studies, organized programs and networks of schools. The role of integrated learning is explored globally with selected countries that do well on international testing such as East Asia, Finland, and Quebec, Canada. IB schools, Ontario, Canada and United States are also considered.

A general conclusion of the review is that integrated curriculum can address the current tension prevalent in educational reform. Research since the 1930s consistently shows that students who experience such approaches are as successful academically, and often more successful, than their counterparts. As well, they develop the skills and values necessary to be successful in the global world they live in. Finally, these students are more engaged in school and more motivated to learn.

Finally, factors for successful implementation are derived from the research.

The study

Twenty-four participants were recruited for the study. Participants were evenly distributed between IB's three geographic regions with 8 participants (33.3 % of the total sample) coming from each. Consistent with IB's demographics 13 participants worked at international schools (54.2%), 7 worked at private schools (29.2%) and 4 worked at public schools (16.6%). The majority of the participants were female (83.3%) and the mean number of years participants had been teaching was 15.4 years with the mean number of years participants had worked at IB schools being 8.0 years. In terms of their roles, 12 participants (50%) were classroom teachers, 6 participants (25%) were specialist teachers, 4 participants (16.7%) were coordinators and 2 participants (8.3%) were administrators.

Data collection consisted of in-depth interviews with participants through videoconferencing software such as Skype or over the telephone. Interviews with participants were conducted by one, or both, of the primary researchers and lasted approximately one hour in length. Participants were sent the transcript of their interview so they could provide clarification around what they stated. Participants then sent their checked transcripts back to the researchers.

Data was analyzed using the empirical phenomenology approach. The goal was to comprehend the experience of the participant as it was lived by the participants themselves.

Results

Three major themes emerged across the lived experiences of the 24 participants. They included: "*It's a framework, it's a framework, it's a framework!"; "Get on board";* and "*Their learning journey."* Within each theme were a number of categories that made up the theme.

All the participants identified the PYP as a framework that was designed to promote transdisciplinary teaching and learning. Within the theme "*It's a framework, it's a framework, it's a framework!"* emerged three main categories that related to this theme and included: A framework provides freedom; Personal understanding of the framework; and Concept confusion.

The second major theme that emerged from the participant's responses was the idea that in order for the PYP to function as a transdisciplinary program people needed to "*get on board*" as one participant put it. The participants articulated there were multiple components that needed to be in place for true transdisciplinary teaching and learning to occur within the PYP and these components were the categories that made up this theme. They included: Educator's Philosophy and Attitude, Administration, Timetabling, Collaborative Planning, PYP Planner Issues, Lack of Experience with PYP, Professional Development and Parents.

Despite some of the issues the participants discussed which made implementing transdisciplinary teaching and learning in the PYP a challenge, they all stated the PYP benefited students and aided them in "*their learning journey*". In this theme three categories emerged from the

participant's responses: Rich Performance Assessment Tasks (RPATs), Student-directed Learning, and IB Program Alignment.

Recommendations

The recommendations were based on the literature review, the results of the study and an analysis of the PYP documents.

1. Keep transdisciplinarity as a philosophical direction (and its underpinnings such as constructivism, holistic education, student-centred, international mindedness, concept-based, skill-based and the IB Learner Profile).

2. Consider shifting the direction of transdisciplinarity from concept-based to project-based learning (which is how many IB educators are actually practicing transdisciplinary curriculum at this time). PBL can be disciplinary, but the richer the summative performance task the greater the likelihood of it being transdisciplinary.

3. Consider restructuring the timetable so that inquiry gets a block of uninterrupted time on a regular basis during the day and is ongoing during an inquiry unit.

4. Keep collaborative curriculum planning. Involve specialists more equitably in this planning.

5. Simplify the PYP planner. Consider an overarching graphic to determine concepts, skills and the way students should be (IB Learner Profile)

6. Consider beginning the planning with a question, rather than a statement.

7. Reduce the concepts to one or two per unit and do not differentiate between transdisciplinary and disciplinary ones. Consider calling these big ideas as some participants did in the interviews. This should take the pressure away from whether something is disciplinary or transdisciplinary.

8. Keep the transdisciplinary skills and articulate the procedural process so that all students know what the steps that they are to do.

9. Include the IB Learner Profile in the backward design planning so that is a conscious part of the teaching/learning and not just happenstance.

10. Consider emphasizing assessment as seamless with curriculum and instruction. Focus on creating a rich performance assessment task for students to demonstrate their learning of the concepts, skills and the attributes of the IB Learner Profile as key to creating an engaging and rigorous curriculum. The Grade 5 Exhibition is one such example, but every major unit can end with a rich performance assessment task. Include "assessment for learning" in professional development and curriculum planning.

11. Consider integrating technology into instruction and assessment provided that the technology enhances the learning and is not done solely for the sake of being able to say technology is being integrated into the program. It is also important that technology not be used as a ‘babysitter’.

12. Continue with your extensive professional development program but find ways to make it more authentic and develop ways for the information provided to be disseminated more widely and accurately.

13. Add sessions on how to integrate technology effectively into the IB classroom into your professional development program.

14. Promote stories of success through publications, classroom observations or video “selfies” or social media. Let practitioners know what a great IB classroom looks like with vivid “pictures” created by other practitioners.

15. Hire more trained IB teachers. Partner with teacher education programs to teach the IB philosophy.

16. Align the program from PYP to DP.

Introduction

The International Baccalaureate (IB) Primary Years Program (PYP) for students aged 3 to 12 years is known for both its rigour and relevance. PYP is grounded in a strong transdisciplinary framework based on the work of Ernest Boyer (1995) and others. The framework is holistic in nature with an emphasis on the whole child and authentic and significant inquiry. The importance of the disciplines is acknowledged, but disciplines alone are not enough. Students need to learn the concepts and skills that transcend the disciplines and fall into the transdisciplinary realm. Through this process students learn to be internationally minded, to be able to work collaboratively to solve the complex problems in the interdependent world we live in. To acquire international mindedness students need to demonstrate the attributes in the IB Learner Profile. These attributes are: inquirers, knowledgeable, thinkers, communicators, principled, open-minded, caring, risk takers, balanced and reflective.

Although the prepared material for PYP educators is clear and accessible in *Developing a transdisciplinary programme of inquiry* (IBO, 2012a) and *Making the PYP Happen: A curriculum for international primary education* (IBO, 2009) there is an on-going tension between the roles of individual disciplines and transdisciplinarity. There is a current trend for increased subject specialization in some primary IB schools.

Recent IB research has further differentiated along a continuum of curriculum integration moving from disciplinary to multidisciplinary to interdisciplinary to transdisciplinary as seen in documents such as *Approaches to Learning: Literature Review* (Li, 2012) and *Developing and Assessing Thinking Skills: The International Baccalaureate Project 2014* (Swartz & McGuiness, 2014). Previous research suggests educator's practice may fall along this continuum rather than be either disciplinary or transdisciplinary (Fogarty, 1991; Jacobs, 1989). Educators tend to move further and further along the continuum as they become more and more familiar with integrated approaches and what they mean in practice (see, for example, Drake 1991, 1993). It then would be logical to expect that some of the work done in PYP schools will fall on a continuum from disciplinary to transdisciplinary work. Working at different levels of integration may address some of the issues around the balance between subject areas and transdisciplinarity.

The purpose of this study was to investigate how PYP teachers, coordinators and administrators conceptualize and apply transdisciplinary approaches to teaching and learning as part of their practice and how they balance disciplinary and transdisciplinary learning. A second purpose was to explore PYP teachers', coordinators' and administrators' lived experiences working in the IB PYP. A deeper understanding of how IB educators are making meaning of, and implementing, the mandated transdisciplinary PYP could facilitate some resolution of the tension between disciplinary and transdisciplinary approaches.

Research Questions

The overarching research question for this study was how do primary educators in IB schools translate transdisciplinary theory into practice? Additional questions explored through the PYP teachers', coordinators' and administrators' lived experience of transdisciplinary theory included:

1) How did the participants in the study understand, define, plan for and approach transdisciplinarity?

2) What barriers did participants identify which hindered their ability to deliver a transdisciplinary program?

3) What supports were provided to help participants deliver a transdisciplinary program?

Review of the Literature

As we move deeper into the 21st century, educators are caught between two seemingly contradictory challenges: 1) How do we satisfy accountability demands and 2) How do we prepare students to live successfully in the 21st Century? Can we address both needs at the same time? And where does curriculum integration fit in this 21st Century context?

Integrated curriculum has a long and important history, particularly in North America. But, curriculum integration has not been, and still is not, that well understood. For some, much of the confusion and ambiguity surrounding curriculum integration is the result of researchers and practitioners not having an historical understanding of the concept (Beane, 1997; Brough, 2012; Dowden, 2007, 2011; Wraga, 1997). More specifically, the lack of a clear definition of integrated curriculum has hindered practitioner understanding (Lenoir & Hasni, 2010). Additionally, the lack of empirical evidence of success has been problematic (Applebee, Adler, & Filhan, 2007; Brewer, 2002; Czerniak, Weber, Sandmann, & Ahern, 1999; Lake, 2000; Orillion, 2009).

We explore the research in curriculum integration from Kindergarten to Grade 12 (K-12) to provide a deeper understanding of integrated curriculum. To search the literature, integrated curriculum was loosely defined as curriculum in which two or more subjects were deliberately combined. In this review, interdisciplinary curriculum and integrated curriculum are used interchangeably. We do this for simplicity in the actual writing and to avoid repetition. We recognize that the two terms can be seen as essentially different orientations; for example, interdisciplinary retains disciplinary/ subject characteristics but uses generic skills to integrate, while integrated curriculum strives to overlap/interweave/ integrate at the subject level.

Searches were conducted in educational databases including Academic Search Complete, Education Research Complete, ERIC, Scholars Portal E-Journals, and journals such as *Educational Researcher* and *Journal of Experiential Education* included in Sage Journals Online. While integrated curriculum occurs at all levels of schooling, we focused primarily on Grades K-12 and less so on higher education. While most of the literature accessible to us as English readers comes from the USA, Australia, and the British Isles, we were able to broaden the geographical perspective by locating articles in English addressing some international studies. We also reviewed documents from selected countries where students do well in large-scale standardized testing to explore any connections with integrated approaches. Initial search words included multidisciplinary curriculum, interdisciplinary curriculum, transdisciplinary curriculum, fused curriculum and cross-curricular (Wraga, 2009). Further searching considered the application of integrated curriculum to “project-based curriculum”, “inquiry learning”,

"experiential learning", "environmental curriculum", "sustainability curriculum", "service learning" and "International Baccalaureate" because all these approaches are associated with integrated curriculum.

It was difficult to gain an understanding of how European countries are handling curriculum integration thus our coverage is limited. In 2010, we learned that Spain was not committed to interdisciplinary approaches in compulsory education, but there were successful examples on non-compulsory education such as learning a second language in relationship with other disciplines and a photography and math project (Segovia et al., 2010). In France, there was high resistance to interdisciplinary practice largely due to issues with teacher identity despite the fact that there is widespread mention of interdisciplinary work in all subjects in curriculum policy to prepare students for living in the 21st Century (Bailat & Niclot, 2010). In Switzerland multidisciplinary and interdisciplinary were an important part of policy but political social structures and resistant teachers hampered its implementation (Ghisla, Bausch & Bonoli, 2010). This resistance to integrated curriculum and our use of English only material may also account for this lack of European research.[1]

We did not include the integration of technology such as the use of Ipads or Wikis as curriculum integration. Technology offers tools; ideally, their use enhances curriculum delivery. But the tool itself, or learning how to use it, is not, in our view, a discipline. In the field, teachers are using the concept of TPACK (technological pedagogical content knowledge) as a systematic approach to insure a fit among technology, pedagogy and content knowledge rather than using technology for its bells and whistles (Koehler &, Mishra, 2009). Ruben Puentedura (Common Sense Education, 2014) developed the SAMR model, which has four levels that are likened to a ladder. SAMR stands for Substitution, Augmentation, Modification and Redefinition. At the bottom of the ladder, teachers replicate or augment what they are already doing, substituting a newer form of technology for whatever they used before. These first two steps are identified as reproduction and natural in an evolving process of teachers learning to infuse technology into their practice. The next two steps are modification and redefinition. The latter two steps actually transform practice while keeping the heart of the lesson intact. The SAMR Model calls for the continual re-examination and reflection of practice.

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[1] In 2009, in a report on the arts in schools in European countries, curriculum integration was mentioned specifically (European Commission/EACEA/Eurydice, 2009). The arts could be taught as separate subjects or integrated together. As well, integrating the arts with other subjects was encouraged in the policy of nine countries. All countries had compulsory arts at the lower levels but they become optional for older students. A 2011 European Commission/EACEA/Eurydice report on science outlined how European countries treated science education. All countries had a general science course in the primary years and this changed as the students got older and science was differentiated into physics, chemistry and biology.

In 2015, the policies for the recommended annual instruction time for each subject in each European country was basically discipline-based. Sub-disciplines were integrated into the categories, for example, history, geography, philosophy, politics and civic education were all under the umbrella of social studies. However the possibility for integration was acknowledged:

> One single value for instruction time is provided for two curriculum subjects together. This is the case when two subjects (social studies and natural sciences for example) are amalgamated into one single subject in the national curriculum. It might also be the case that one particular subject, ICT for example, is taught when teaching another subject, natural sciences for instance. The value for instruction time for these two subjects is given to the curriculum subject for which the biggest value is expected, and a country specific note specify the subjects concerned." (European Commission/EACEA/Eurydice, 2015 p. 23).

21st Century Context

The tension between the need for accountability and the need to create an educational system that works in the 21st Century permeates educational jurisdictions around the world. Most school systems today are embedded in a culture of accountability driven economically by neoliberal reforms where integrated and student centered approaches are hamstrung by educational policy and a testing culture (Lam, Alviar-Martin, Adler & Sim, 2013). Accountability is generally associated with the traditional model of education where the practice includes the teacher as expert who lectures to the passive students, back to the basics (the 3 Rs), discipline-based, and standardized testing.

Today, accountability takes on a global context. Educators know what each other are doing and are able to compare and contrast practices. Test scores are an important marker of the success for students, teachers, administrators and systems. Rankings in international tests such as Programme for International Student Assessment (PISA) are extremely influential. PISA measures achievement in numeracy, literacy and science for 15-year-olds. This, among others tests, is administered by the Organization of Economic and Community Development (OECD). OECD rankings are perceived to be a predictor of success and are an important measure of accountability for educational systems. For example, the OECD report, *Universal Basic Skills – what countries stand to gain* (OECD, 2015), concludes that the quality of schooling is powerful predictor of a country's future wealth.

Improving or maintaining OECD rankings can determine funding, policy and even real estate values in local communities. For example, Canadian students in Ontario and Alberta dropped in the rankings for mathematics in the last PISA testing session. As a result, policy for the teaching of math is moving away from the constructivist discovery method to primarily using the traditional method of rote learning with a small percentage of discovery method (Stokke, 2015).

Juxtaposed to the need for accountability is a strong international call for educational reform. The world has changed dramatically. Multiple literacies and the Web 2.0 world, for example, didn't exist a generation ago. The rapidity of change ensures that teachers today cannot anticipate with certainty the future their students will face. The call for reform involves a new pedagogy that promotes deep learning, appropriate integration of technology and the development of 21st Century skills such as collaboration, citizenship, creativity, communication, higher order thinking skills and global mindedness (see, for example, Fullan, 2013; Hargreaves & Shirley, 2009; Hattie, 2012; Kay, 2011). OECD also recognizes the need to define universal basic skills beyond traditional literacy and numeracy. Schleicher (2015), Director, Directorate for Education and Skills for OECD blogs:

> Importantly, the post-2015 agenda is no longer just about providing more people with more years of schooling, but about making sure that individuals acquire a solid foundation of knowledge in key disciplines, that they develop creative, critical thinking and collaborative skills, and that they build character attributes, such as mindfulness, curiosity, courage and resilience.

Popular responses to this call for reform are integrated curriculum, inquiry-based learning, and project-based learning (see, for example, Vega, 2012a; Vega, 2013a). Visionary documents such as *Equinox Blueprint Learning 2030* (Brooks & Holmes, 2014) emphasize the importance of implementing such approaches for addressing challenges in the future. As well, the teaching and assessing of 21st Century skills are important globally according to the 2013 Rand report *Measuring 21st Century Competencies: Guidance for Educators* published by the Asia Society (Soland, Hamilton & Stecher, 2013).

From the reform perspective, it seems that the 21st Century view of the learner and of curriculum organization has much in common with the constructivist view developed in the progressive era of education, influenced by the work of John Dewey (1997/ 1965/1938). Progressive educators espoused the value of interweaving disciplinary subjects into relevant and meaningful contexts and looking at knowledge from more than one perspective beginning in the early twentieth century. For Dewey, it was important that students were inquirers, and used the scientific method to solve problems. The notion was that curriculum integration would intrinsically motivate learners, improve student-teacher relationships and provide a place for democracy to flourish (Beane, 1997; Vars, 1997). Almost a hundred years later, many still maintain that students will be more engaged and motivated to learn if they learn from an integrated perspective.

The call for reform is predicated on a belief that traditional education is not working anymore. Too many students view schooling as something to endure before "real life" begins. This depressing perception is supported by a 2013 Gallup poll of over 600,000 American students. Results indicate that only 55% of students are "engaged", 28% are "not engaged" and 17% are "actively disengaged"—feeling negatively about school and likely to spread that negativity. Engagement falls steadily as students advance in school (Gallup, 2014, p.13). According to the first national report of the Canadian Education Association (Willms, Friesen & Milton, 2009), based on an online survey of 32,322 students in Grades 5 to 12 across Canada, intellectual engagement begins to fall in Grade 6 and reaches a low of 30% by Grade 9, remaining there throughout the high school years. Attendance is 90% in Grade 6 and 40% by Grade 12. While socio-economic factors are influential, only 41% of the highest socioeconomic status (SES) students described themselves as intellectually engaged at school. A similar pattern occurs in Australia: students become less engaged the longer they stay in school. A survey of over 5000 students in Years 5 to 12 found that 74% of Year 5 students described themselves as engaged, but only 58% said so in Year 8, and by Year 12, only 51% described themselves as engaged (Jasperson, 2014).

Today, educators are questioning traditional curriculum content, organization and implementation, because they know that student engagement and achievement are strongly linked (Lee, 2014). Methods of teaching are changing and becoming more diverse. Attention is shifting away from the traditional transmission model of education in which the teacher presents subject-specific knowledge in isolated, sequential time-slots to passive receiver students. The concept of the learner has changed. A contemporary view sees the learner as an active, self-aware collaborator, responsive to and responsible for his/her own learning (Huber & Hutchings, 2004). This view encourages a more personalized curriculum and shifts the emphasis of assessment away from standardized summative assessment to performance assessment, formative assessment and self-assessment. Emergent understandings from cognitive science

about transference, brain plasticity and the importance of metacognition support the notion that active engagement and personal connection are necessary for deep learning (Doidge, 2007; Willis, 2006, 2008, 2011).

Curriculum integration can provide a new approach to teaching and learning. With the amplification of globalization and technology, the need for integrated curriculum grows more urgent say Huber and Hutchings (2004), Kay (2011) and Moss, Osborne & Kaufman (2008). Indeed, in 1986 Beane, Toepfer and Alessi predicted that integrated curriculum would inevitably be the way to insure curriculum is relevant and engaging to students.

Integrated curriculum rests on the premise that applying a constructivist approach will prove more engaging to students (Beane et al., 1986; Beane, 1991; Clarke & Agne, 1997; Drake, 2007, 2012; Maurer, 1994; Moss et.al., 2008). As well, integrated curriculum has long been popular with educators favouring "child-centered", "problem-centered", constructivist and holistic views of learning (Beane, 1997; Miller, Cassie, & Drake, 1990).

Assessment in interdisciplinary programs tends to go for the "big picture" in order to incorporate multiple disciplines. Thus, integrated curriculum fits into contemporary assessment practices. Portfolios, demonstrations, capstone projects, media presentations and performances in authentic contexts are typical assessment tasks in integrated programs (Huber & Hutchings, 2004; Moss, Osborne & Kaufman, 2003; Ontario Ministry of Education, 2002a, 2002b, 2002c). The literature abounds with examples of assessment tasks that require the integration of content knowledge from various disciplines and the application of cross-curricular skills, or the demonstration of knowledge and skills synthesized from various disciplines. For example, a senior student created and implemented an after-school integrated arts program for an under-serviced neighbourhood as her final "exam" (Nathan, 2008). Other examples can be found in the following articles: for science and literature, Bettely and Lee (2009); for art and science, Haley and Dyhrman (2009) and Moses (2008); for literacy and science, Marcum-Dietrich, Byrne and O'Hern (2009); for literacy, science and technology, Sanders and Pavelski, (2009).

Curriculum integration, however, is not a magic bullet; it can be delivered in as deadly a fashion as any other curriculum. Also, simply calling a program "integrated" does not make it so. A so-called integrated unit on a single theme, apples let's say, may be really a series of activities that do not contribute to connected understandings. However, while the assumption of increased student engagement may sometimes be false in practice (Ladson-Billings, 1995), curriculum integration is usually set within a paradigm that represents the constructivist worldview, whether it is in the progressive era of the 1930s or the 21st Century. Ladson-Billings emphasizes that integration must reflect a coherent philosophical and pedagogical position on the "how" as well as the "what" that is to be learned. In this paper, we work with the assumption that integration takes place within a constructivist paradigm, and we review literature that reflects a coherent philosophical and pedagogical position.

Defining Integrated Curriculum

In 2001, Hurley noted the multiple forms of integrated curriculum that had emerged in the 21st Century and identified the paradox that although there are many variations in practice, there is an

ongoing demand for one general definition of integration. This paradox is still evident in 2015. Educators define integrated approaches in a wide variety of ways such as cross-disciplinary, intradisciplinary, fusion, multidisciplinary, interdisciplinary, transdisciplinary or integrated; implementation of integrated curriculum can look significantly different from one unique educational setting to another. As well, curriculum integration includes many forms such as thematic units, project-based learning, problem- based learning and place-based learning and even passion-based learning. The inconsistency of terms and models is a repeated source of frustration for researchers of integrated curriculum (Czerniak et al., 1999; Hurley, 2001; Pang & Good, 2000).

The continuum perspective: For many theorists, integration can be seen as on a continuum moving from a disciplinary approach to more and more connections and greater and greater degrees of integration (Daly, Brown & McGowan, 2012; Drake, 2012; Fogarty & Pete, 2009). For Drake, this continuum came from a personal experience. Charged with developing an integrated curriculum by the Curriculum Superintendents of Ontario, she led a team of six educators from across Ontario. They built on Drake's first interdisciplinary curriculum that connected mythology to the real world (Miller et al., 1990). This team developed The Story Model (Drake et al., 1992). Drake documented the actual experience of developing this curriculum collaboratively in "How our team dissolved the boundaries" (1991) published in *Educational Leadership*. The article described how the longer the team worked together, the more connections became obvious, and disciplinary boundaries dissolved – not once, but twice. An academic pointed out to her that there was a theory to describe the team's experience: multidisciplinary, interdisciplinary and transdisciplinary. Figure 1 illustrates the continuum of integration.

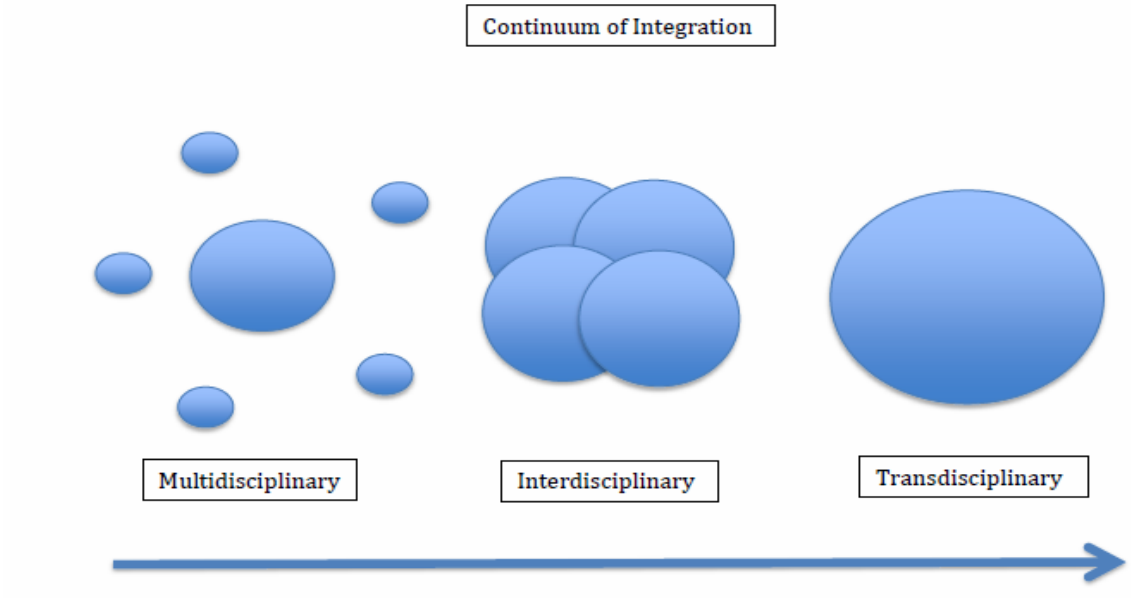

Figure 1: Continuum of Integration. Adapted from Drake (1991).

Drake also interviewed practitioners in jurisdictions that had embraced integrated curriculum. The resulting monograph for ASCD (Drake, 1993) describes the journey that educators made as they shifted their practices. This book also describes the different orientations and the *distinct differences* among orientations. These definitions are summarized below.

Multidisciplinary: In the subject-centred, or multidisciplinary approach, a central theme is identified and used to organize and correlate the disciplines being integrated (Brough, 2012; Dowden, 2007). Discipline integrity is preserved as learning activities are shaped around subject areas so that discipline-based connections are recognized in terms of unique discipline-based concepts such as civilizations, landforms and tempo, or shared disciplinary concepts such as patterns, systems and continuity and change. For example, students may be taught to recognize patterns in customer spending (mathematics discipline) and patterns in language use (language arts discipline) in advertisements in a media unit.

Assessment is clear for each discipline. In elementary schools, there might be learning centres; each centre includes activities from one subject area. In high school, a common theme or issue is studied in subject-based classrooms. For example, the issue of global warming is studied in geography class (What areas of the world are affected by global warming?), in science class (How do carbon emissions cause global warming?) and math class (How do we analyze the data measuring global warming?). The teacher(s) may or may not make the connections explicit for the students. Sometimes the culminating activity requires the integration of the skills and knowledge of the subject areas.

Interdisciplinary: The subjects are still relatively clear in their differences, but now the organizing centre is the interdisciplinary key concepts, skills and attitudes and actions. The emphasis is on big ideas such as sustainability, change and continuity and systems, or big complex interdisciplinary skills such as communication, critical thinking and problem-solving and citizenship. Boundaries are blurred somewhat, and sometimes there are questions about what subject is actually being taught at the moment. Assessment may reflect particular disciplinary standards that are met, or sometimes each discipline may receive a similar grade in the interdisciplinary aspect that has been demonstrated by students. For example, measuring collaborative problem-solving could involve several subjects and the grading might reflect this.

Transdisciplinary: Transdisciplinary means to go beyond the disciplines. The organizing centre is the real world context. Students explore a problem or issue. A question might be, 'How should we respond to a global issue in a local context?' Students could design and implement a community awareness and action campaign. Students' questions (as opposed to those created by the teacher) form the focus in this approach. If you deconstruct the learning in this approach, the disciplines are present and can have a place, but transdisciplinarity takes precedence. Richard and Bennett (2011) share their thinking around a transdisciplinary summer camp for teachers of Grades 4 to 6. They define the approach as an examination of multiple disciplines to integrate knowledge and state that this is the highest level of integration.

The International Baccalaureate Primary Years Programme (IB PYP) is transdisciplinary "to convey that learning has relevance across subject areas and more importantly the learning transcends the confines of subject areas to connect us to what is real in the world" (IBO, 2012b,

p. 1) . IB argues that transdisciplinary education is built around a core that is surrounded by selected knowledge and skills of different subject areas. The core includes key concepts that go above and beyond the disciplines, transdisciplinary skills, attitudes and action. This vision is holistic in nature. In looking across the entire IB curricula, it appears as if it too employs a continuum. The Primary Years Programme (PYP) is transdisciplinary, the Middle Years Programme (MYP) is interdisciplinary and the Diploma Programme (DP) is primarily disciplinary with a few interdisciplinary courses.

Other continuums have also been suggested. Burton (2001) recognizes three levels of integration. In *thematic integration*, subjects are distinct but share a focus on a theme. *Knowledge integration* promotes interactive connections between two or more disciplines through shared planning and teaching. The greatest extent of interdisciplinary connection occurs in *learner-initiated integration*. This level assumes the application of higher level thinking skills as students independently discover connections by bringing together prior disciplinary knowledge and new information.

The Consortium of National Arts Education Associations (2002) focuses on pedagogy rather than on subjects and their content for its continuum. It describes three models of instruction along a continuum of increasing degrees of integration. The least integration occurs in *parallel instruction* in which two teachers maintain disciplinary approaches to a common topic or concept. Students make connections thanks to the synchronicity of instruction. More explicit integration occurs in *cross-disciplinary instruction* in which teachers collaboratively plan and perhaps team-teach around a common theme or problem. Finally, in *infusion*, a team of teachers plans instruction around a common topic or problem that requires the integration of knowledge and skills from various subject areas. See pages eight to 10 of *Authentic connections: Interdisciplinary work in the arts* (Consortium of National Arts Education Associations, 2002) for examples of each of these models.

Issues with a continuum. Some, however, caution against seeing integration on a continuum. Thinking of curriculum along a continuum is still rooted in the notion of knowledge as disciplinary, even when the new knowledge is described as 'transdisciplinary'. Referring to Bean (1995), Brand and Triplett (2012) write that:

> Interdisciplinary teaching is more than an organizational strategy; it is a way of thinking about the purpose of schools, curriculum sources and the way in which knowledge is used. Students who have encountered instruction from an integrated focus are motivated to broaden their conceptions of themselves and the world, as well as acquire and utilize knowledge authentically (p. 381-382).

Writing in 1996, Hargreaves, Earl and Ryan argue that the complexity of different integration approaches cannot be captured on a continuum. As Chrysostomou (2004) states, the organization of curriculum integration along a continuum can lead to problematic assumptions. One caution is that there is an assumed hierarchy of "better than" or of "more progressive than" or "more innovative than" with increasing degree of integration.

In Australia, Rennie, Venville and Wallace (2012) completed 20 major case studies on curriculum integration with added revisits to 9 of the schools later from 1997 to 2008. They offer their own categorization of integration from synchronization, thematic, project-based, cross-curricular, school-specialized and community focused. These researchers noted that a continuum represents an implicit suggestion of progress but they found "while approaches to curriculum may be different, there is no inherent quality of 'betterness'; rather the effectiveness of each must be judged according to its purpose" (p. 19). Venville and colleagues define integrated curriculum broadly as a way that enables students to "look towards multiple dimensions that reflect the realities of their experience outside and inside school" (p. 19).

Others do not accept the concept of a continuum and say this view ignores history and lacks logical justification (See, for example, Dowden 2007 and 2011). Gehrke (1998) suggests that we could view integrated curriculum as having two basic forms. *Either* the curriculum is subject-centred *or* student-centred. The specific term for the subject-centered approach is multidisciplinary (Beane, 1997; Brough, 2012; Dowden, 2007). In the subject-centered form, the disciplines are the building blocks; regardless of how they are combined, the subject areas are never lost. The student-centred approach is referred to as the integrative model (Beane, 1993, 1997; Dowden, 2007). In the student-centered form, the students are confronted with issues, problems and concerns. Although the disciplines may be recognized here, they are not the starting point. This second iteration can be the starting point of student-centred project-based learning today.

The student-centred integrative model of curriculum grew out of Beane's (1997) historical work on progressive education theorists, especially the democratic ideals of Dewey (1956/1902/1900). Beane believes that students are most engaged when answering their own questions and that students are capable of asking meaningful questions. When these questions are organized into personal and social concerns, they generally cover the required curriculum. His initiating questions are what questions and concerns do you have about yourself, and what questions and concerns do you have about your world. The themes of study emerge from the answers students give. For Beane, any form of integration other than the integrative model is inauthentic. He does not abandon disciplines; they are used as resources to explore the themes and to create learning and teaching activities.

Theorists in the "either/or" camp acknowledge that a continuum may be useful if it is seen as a range of multidisciplinary practices; the integrative model stands alone as the only integrated one and thus is not on the continuum. Practices on the continuum lean toward progressive ideas or might describe stages of professional development that educators go through as they put aside traditional single subject approaches. As well, the continuum may be useful as educators work through the implications of implementing curriculum integration in the classroom (Bergstrom, 1998; Brazee & Cappelluti, 1995; Snapp, 2006).

Finally, Drake found that the deeper that education got into the standards-based movement, the more indistinguishable multidisciplinary, interdisciplinary and transdisciplinary became in practice (Drake, 2007; 2012). Almost every district that chose to implement some form of integrated curriculum was mandated to meet a set of standards and students had to be a part of large-scale testing. For Drake, only the starting point for integrated approaches on the

continuum in a standards-based system is different. In multidisciplinary, you begin with standards from different disciplines and integrate through the lens of a common theme; in interdisciplinary, you look for common concepts or skills embedded in the standards. Transdisciplinary begins with the real world context. But each context is shaped by the standards.

For example, Drake and Burns (2004) categorized the Alpha program, a school within a school established in Shelbourne, Vermont, as transdisciplinary. Based on James Beane's model, the curriculum was developed from student concerns about themselves and their larger world. Students would co-create the curriculum with their teachers. But as time passed and the standards movement took over, the Alpha program changed with the times. Today, curriculum design is still rooted in student questions and concerns. This is the starting place. But the program is standards-based. Students map out the disciplinary standards and co-create the activities and assessments with the teachers to meet these standards. Assessment is important in the program. Students do weekly goal setting around Vermont's Vital Results (communication, problem-solving, functioning independently, personal development and civic and social responsibility). According to teacher Meg O'Donnell (as cited in Drake, 2012), students do as well as, or better, than students in traditional classes on standardized measures even if they do not prepare for them as explicitly as those students in the traditional classrooms. As well, Alpha students are well-prepared for high school and beyond; they are active thinkers who ask deep questions. To put this in context, Beane does not accept the concept of a continuum. He defines this program as the integrative model and sees it as the only way to integrate the curriculum as discussed above.

Teacher perceptions. A lack of a clear definition is also an issue for teachers around the world and seems to contribute to conflicted perceptions and spotty implementation.

In Turkey, the policy has been an integrated curriculum from Grades 1 to 12 since 2005. The new curriculum shifted from a behaviourist orientation to a constructivist one. However, Professor Behsat Savaş from Mehmet Akif Ersoy University says implementation has been a challenge and integration has only worked from Grade 1 to 4. The subject-specific higher grade teachers rarely meet with each other. Savaş claims that integration would work more effectively if teachers had understood the concept better and had an easy way to implement it (personal communication, June 26, 2015).

Leung (2008) explored Hong Kong teachers' perceptions of Project Learning. He surveyed and interviewed 15 Hong Kong teachers from three government-subsidized primary schools. Each school interpreted Project Learning in a different way, but all teachers deemed that teaching the generic skills and 'lifewide' learning was important. Only one school chose an interdisciplinary approach. Concerns about Project Learning arose over difficulties in finding an appropriate theme, lack of resources and professional development. Teachers perceived that the benefits included an enhanced learning environment, better student-teacher relationships and teacher-parent relationships and the all-round development of the student.

Lam et al. (2013) explored 11 Singapore teachers' conceptions of teaching and learning who implemented integrated curriculum. The researchers found that the teachers' conception did not

neatly fit the models found in the literature (and the ones offered above in this review). Teacher understanding was linked to the type of integration being implemented in their schools. Background knowledge consisted of attending Ministry of Education (MOE) short seminars and Masters courses on concept-based curriculum design. For more than half these teachers perceived that, "their efforts fell short of what integration should be" (p. 29). These teachers did find positive effects on the camaraderie of teachers, and all but one agreed that "integration offered many benefits, particularly in cultivating students' learning and interest" (p. 29). Nevertheless these teachers did not think teachers in Singapore would implement such approaches unless the MOE was fully committed.

Applebee et al. (2007) completed an in-depth study of 11 interdisciplinary school teams with 30 teachers and 542 students in the middle school environment in New York and California. The researchers constructed an interdisciplinary continuum from pre-disciplinary, disciplinary correlated, shared, to reconstructed curriculum. Teams were selected that were deemed to be stable, had established curricula and that represented these approaches. The researchers focused on two aspects of instruction: 1) tools that facilitated new ideas and 2) classroom interactions that involved discussion rather than recitation. They also looked at the number of interdisciplinary connections being made compared to disciplinary teaching. Interviews and observations revealed that teachers' conceptions and practices of integrated curriculum did not necessarily match the 'model' that they thought they were implementing. Regardless of the choice of integration, there were times when teachers reverted to disciplinary study.

In Quebec, Canada, interdisciplinarity has been discussed at the provincial level for the past 45 years or so (Lenoir & Hasni, 2005). There has been an integrated competency-based curriculum policy in place since 2001. Lenoir and Hasni (2010) claim that in 25 years of researching with over 1600 primary teachers, there has been no clear definition of what curriculum integration is, nor have teachers come to any clear common understanding. This is a "crucial and fundamental problem – the absence of a definition of concept or its attributes by the MEQ [Ministry of Education, Recreation and Sports Quebec]. This lack of conceptual clarification leaves the door open to any interpretation…" (p. 262). Lenoir and Hasni found teachers' conceptions of interdisciplinarity fell into four categories conceived on a Cartesian axis (Figure 2).

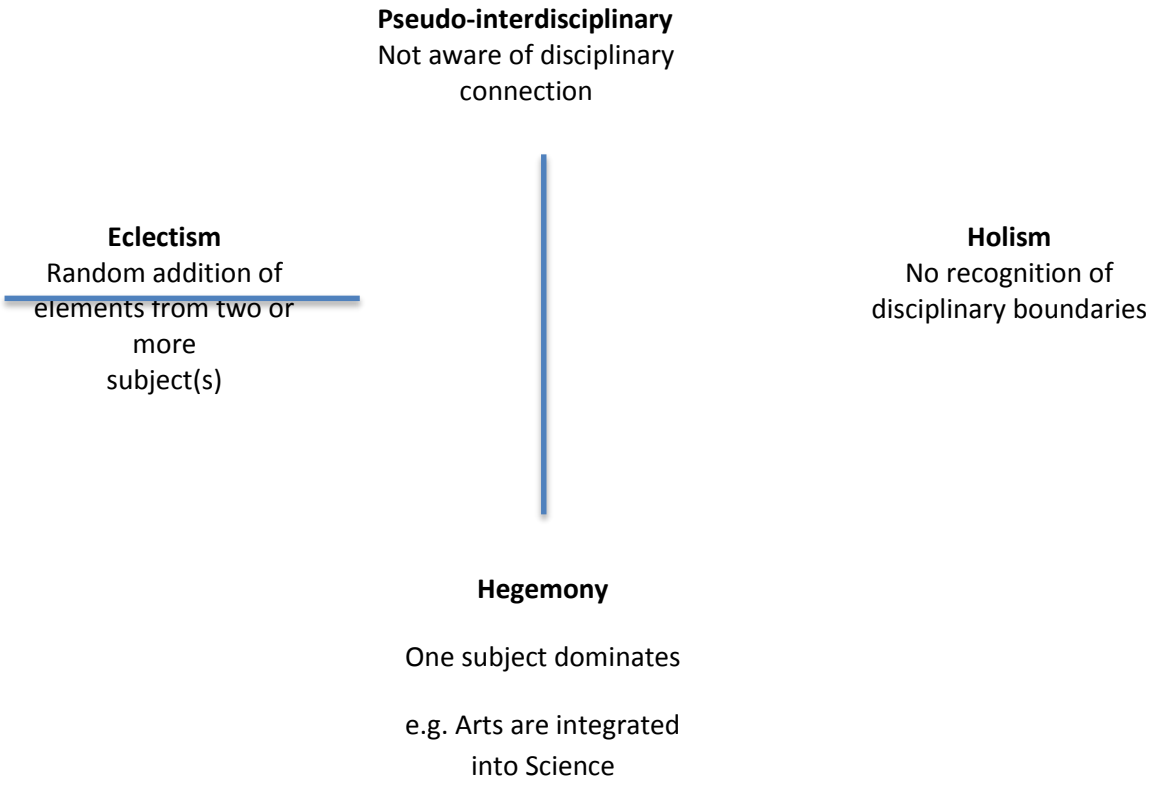

Figure 2: Adapted from "Poles of interdisciplinary practice in Quebec Primary Education" in Lenoir & Hasni (2010, p. 267). *Issues in integrative studies, 28*, 238-294.

Are there any examples of educators gaining understanding of different theories of integration? In Ontario, Canada, from 1991 to 1994, educational policy mandated integrated curriculum from Grades 1 to 9. This was the first venture of the province into outcome-based education. Drake worked at a local high school, and with her colleagues implemented several different versions of integrated approaches. Here she learned what worked, and what did not. There were few experts in the procedure. And there was not yet the strict adherence to meeting outcomes that was soon to affect curriculum decisions with the rise of the accountability movement. Teachers were generally very confused as to what integrated curriculum actually was and were hesitant or even hostile to implementation. Drake herself provided training across the province for different school boards. She found that describing integration using the terms multidisciplinary, interdisciplinary and transdisciplinary helped people make sense of possibilities. Teachers also connected to Fogarty's (1991) continuum of 10 ways to integrate and Jacob's work (1989), which were popular at the time. In hindsight, the continuums were simplistic, but they allowed educators to make meaning and connect to things that they were currently doing and move forward to experimentation.

Reflections on Defining Integrated Curriculum. Rennie et al., (2012) noted that although they, as researchers, identified the programs in distinct ways, the educators they worked with did not. Regardless of the type of integration that was being implemented, the teachers called it only one

term – integrated. In the final analysis, "rather than talking about interdisciplinary versus discipline-based courses, it may be more helpful to think about the contexts in which both kinds of study are most useful" (Applebee et al., 2007, p. 1035). Pushed to identify which approach to integration was best, Drake (1993) commented that each approach was valid, and that it depended on the context and purpose for disciplinary or interdisciplinary work. It seems there is a time and place for different approaches depending on the goal of the learning.

Working With Disciplines in an Integrated Approach

In this section we explore the interaction of the disciplines with integrated approaches. We are mindful that the definitions we use here fall into disciplinary, interdisciplinary and transdisciplinary categories. We did not find a relevant discussion around multidisciplinary in the literature, probably because the procedures in each discipline remain intact in that approach.

Over the years, there has been tension and confusion about the relationship between the disciplines and integrated curriculum. Some claim that disciplines are the enemy of integration, but Beane (1995) and Boix-Mansilla, Gardner and Miller (2000) see them as allies. Beane (1995) points out that the subject areas are not really disciplines; "they are really institutional based representations of disciplines, since they deal with a limited selection of what is known" (p. 724). Disciplines, as opposed to subjects, are the most sophisticated way of investigating issues (Boix-Mansilla et al., 2000).

Zhou and Kim (2010) emphasize that curriculum integration is more about the development of integrated thinking than about abandoning disciplinary teaching. For them, as for Stein, Connell, and Gardner (2008), integrated curriculum really means synthesizing concepts, knowledge and skills from different subject areas to create distinctly new knowledge and new understandings that could not be derived from a single subject alone.

Jacobs (1991) sees that disciplines have some natural fit with other subject areas. She proposes curriculum mapping as a first step to curriculum design for any program. Mapping is very valuable to ensure coverage and balance when co-ordinating multiple disciplines of an integrated curriculum. Looking at a calendar and at documents identifying what one is supposed to teach in each discipline, the teacher can find natural fits across the curriculum. The next step is to create a unit that puts the disciplines together. Planning across a two to three year span, teachers find logical and natural connections among the different subject areas; there is no need to force fit. This was a very popular model that preceded the standards-based movement.

Gardner and Boix-Mansilla (2000) offer Teaching for Understanding as an approach that is broad enough to include a range of disciplines (although not all disciplines are equal). Students explore an issue or problem such as how a person contracts a cold. What is the source of the disease? What keeps us healthy? What is illness and how do we prevent it? For them, disciplines are "the most useful means for illuminating those generative issues that have perennially engaged the curiosity of the mind" (p.79).

Gardner and Boix-Mansilla (2000) suggest that there are stages that students must go through in order to be ready to work in the interdisciplinary realm. In the first stage, students work with

common sense knowledge. Even children as young as five or six can consider generative questions such as ones about healthy bodies based on their intuitive theories of the world.

The next stage is *protodisciplinary knowledge*. In the absence of disciplinary study, students in late primary can appreciate the difference between a historical account and a literary one. By late middle school, students are usually studying in subject areas and can begin to work with *disciplinary knowledge*. To learn from a disciplinary perspective, Gardner and Boix-Mansilla recommend students first begin by observing experts in the discipline. Then they observe and create exhibitions that capture the accumulated wisdom of the discipline. Students practice working with the concepts, theories and methods of the discipline. Only when students have mastered certain portions of disciplinary skills, but not before, are students able to move into *interdisciplinary projects*. Gardner and Boix-Mansilla see a variety of ways to approach such projects which they describe as multidisciplinary, interdisciplinary, metadisciplinary and transdisciplinary.

Gardner and Boix-Mansilla expand this view in their work on cultivating the "disciplinary mind" (Boix-Mansilla & Gardner, 2008). They write the following:

> In sharp contrast with teaching subject matter, an alternative perspective emphasizes teaching disciplines and disciplinary thinking. The goal of this approach is to instill in the young the disposition to interpret the world in the distinctive ways that characterize the thinking of experienced disciplinarians—historians, scientists, mathematicians, and artists" (p. 14).

Disciplinary expertise, for them, is not the acquisition of many facts; rather, it is an ability to understand the purpose of a discipline, to develop an essential knowledge base, and to apply the method of inquiry and form of communication appropriate to that discipline. However, disciplinary expertise does not exclude integration. Thus, they advocate that:

> To thrive in contemporary societies, young people must develop the capacity to think like experts. They must also be able to integrate disciplinary perspectives...In doing so, the disciplined mind resists oversimplification and prepares students to embrace the complexity of the modern world (p. 19).

A creative response is to use the disciplinary lens to look at a larger problem or issue that is not discipline-based. Lauritzen and Jaeger (1997) created the narrative curriculum. This curriculum begins with a story or story-like context. Students generate questions in response to the stories. The questions are then explored from a variety of perspectives. The disciplines are used as a heuristic, students use the tools of the disciplines and, for example, think as historians, think as scientists, think as artists, or think as authors. In the narrative curriculum, the story is transformed by the inquiries of the students.

Others take a different view. For Rennie et al., (2012) there should be a balanced perspective between disciplinary and interdisciplinary perspectives. They see the positioning of disciplinary and interdisciplinary as if at odds with each other as a problem. In their view, we need disciplinary knowledge, but we also need to be able to work with "the interdisciplinary nature of

the issues and problems posed by the world outside of school" (p. 157). They describe it this way:

> Within a balanced curriculum, students can be encouraged to reflect on and critique subject-specific knowledge, understand the limitations of that knowledge, particularly in applied situations, and recognize when creativity, lateral thinking, adaptive help- seeking, and trial and error play a role in the knowledge-building process. This broader, more balanced view of curriculum allows students, teachers, and researchers to value disciplinary knowledge and to utilize the cognitive and practical tools that the discipline may offer. At the same time, it allows students, teachers, and researchers to look outward in order to engage in relevant, exciting, and motivating real-world problems and issues, and to explore how disciplinary knowledge can be useful in understanding, addressing, and solving those problems and issues (p. 157- 158).

Transdisciplinarity and disciplines. Klein (2014) discusses how the field of transdisciplinarity has evolved from 1970 to 2014 when the term assumes more meaning as the world becomes more complex. Ten years ago, Klein (2004, 2014) and Nicolescu (2005, 2010) revived the term to respond to the complexity of today's problems and the need to solve them through multiple lenses. By 2014, Klein notes that there has been exponential growth in publications and renewed interest in both the academic and political sectors. Currently at our own organization, Brock University, for example, there are three pillars for planning: transdisciplinarity, 21st Century learning and partnerships.

Complex challenges are the focus of transdisciplinary research and rather than the disciplines. Klein (2014) claims new structures are needed to allow for "a new ontology of methods and tools" (p.70). Today, three discourses are occurring in the field: transcendence, problem-solving and transgression.

When transdisciplinarity is translated into K to 12 practice, the focus is usually on problem-solving from a student-centred perspective. Richards and Bennett (2011) share their thinking around a transdisciplinary summer camp that they designed for Grades 4 to 6 teachers. They define the approach as "synthesis, a fusion, a blending, and an examination of multiple disciplines to integrate knowledge" (Jacobs, 1989, p. 48). The disciplines are included only in so far as they are relevant to the inquiry at hand. Students develop questions around a topic of study and then solve them with relevant disciplines.

Richards (2015, personal correspondence on January 20) describes the relationships among disciplines and transdisciplinarity as follows:

> Basically, a transdisciplinary approach is a process in which a teacher and her students investigate issues and problems by engaging in project- based explorations that span discipline boundaries. However, transdisciplinarity is much more than going beyond discipline boundaries. Transdisciplinarity is a way of thinking about how to acquire knowledge needed to find answers to questions. Moreover, it does not approach a problem through the lens of different disciplines, or use one discipline to inform another (Moss et al., 2003). Rather, it releases students and teachers from the boundary

> limitations of specific subject areas. Students and their teacher are free to rely on relevant disciplines that genuinely support and enrich their inquiries.

As a footnote, although Richards values transdisciplinary work, is publishing in this area and teaches a doctoral class on transdisciplinary research, she does not know of any schools K to 12 where this is actually practiced.

The PYP aims to be inquiry-based and transdisciplinary (IBO, 2009). The goal is to develop "internationally minded people who recognizing their common humanity and shared guardianship of the planet, help to create a better and more peaceful world" and "are active and compassionate lifelong learners". The IB Learner Profile includes attributes such as knowledgeable, inquirer, principled, balanced, risk-taker, and communicator. Each year, students study six units of inquiry that explore one of six transdisciplinary themes; the youngest students study four themes. The themes are: who are we, where we are in time and place, how we express ourselves, how the world works, how we organize ourselves and sharing the planet. In the last year of the primary program students participate in an exhibition of their learning.

A key piece of this program is that teachers plan collaboratively and systematically. Each unit of inquiry has a transdisciplinary theme with related concepts from different disciplines. Students "are supported by knowledge, concepts and skills from the traditional subject areas but utilize them in ways that transcend the confines of these subjects, thereby contributing to a transdisciplinary model of teaching and learning" (IBO, 2012a, p. 1). Teachers also work with subject specific scope and sequence documents. These scope and sequence documents may come from IB, the local education jurisdiction's mandates or have been designed by the school staff. Although the program does include subject areas, it also focuses on making connections across the disciplines and relating to real life. For each theme, it is suggested that a central idea is developed and that two to three subject areas contribute to the understanding of this area. Not all subjects need to be included in each theme. As teachers teach a unit of inquiry, they may need to revert to a subject-specific activity, but teaching relevant disciplinary content/skills within the context of the inquiry is considered to be authentic learning.

A transdisciplinary unit usually begins with the identification of a question, an issue or a problem – the more "problematic", the better. Klein (2014) identifies a wicked problem as one of the kind of problems that fall into the realm of transdisciplinary research. Wicked problems (Rittell & Weber, 1973) are so complex, ambiguous, ill-structured and interconnected that they are probably not solvable. In a wicked problem, one can successfully address one aspect of the problem, yet, while doing so, ten more interconnected aspects emerge that also require solutions. Education, poverty, nutrition and the environment are such problems. Human actions are a part of the problem. The survival of the biosphere is a wicked problem in which we are creating our own demise, what Kolbert (2014) calls the sixth extinction, without fully understanding how we are doing it, given the complex interconnections between humans and nature. Although wicked problems seem perhaps far-reaching for the classroom of today, there are teachers and students wrestling with these problems now.

At the Rotman School of Business, University of Toronto, a program called I-Think is

promoting integrative thinking for students K to 12. Roger Martin (2007) defines integrative thinking as a way to bring together either/or thinking by synthesizing the best of two apparent opposites. Martin believes that this kind of thinking is necessary to help us grapple with the wicked problems of today.

A conversation with Ellie Avishai (personal communication, January 23, 2015) shed some light on the program. Avishai looks at education primarily from a practitioner's perspective. She is the founder and Director of I-Think. From her experience, she believes that students learn the disciplinary content more deeply when they are working on a complex problem than when they are just learning content for its own sake. She sees interdisciplinary work as marrying subjects together, using the skills and knowledge from different subject areas to address the problem. Transdisciplinary goes beyond the merging of specific disciplines. For her, young people have the intellectual capacity to dig deeply into a problem and to come up with creative solutions. They need to learn the tools to do this. I-Think gives them tools to enter a problem that allows for the complexity to unfold. The goal of the I-Think program is not to only learn subject area content, but to harness creativity and curiosity, and encourage students to ask questions.

For younger students, the program can be more teacher-directed, depending on the needs of the students. Kindergarten students, for example, might compare their classmates' Styrofoam boats while Grade 3 students compare math solutions. Both groups are looking for best practices. "I-Think aims to teach students how to tackle problems collaboratively by avoiding either-or comparisons and integrating ideas" (Hammer, 2012).

Heidi Siwak (Drake, Reid & Kolohon, 2014), an Ontario Grade 7 teacher, takes her students through the process. She begins by having them identify the difference between simple, complex and wicked problems. Then she has them create causal maps that explore the interconnected causes of a wicked problem (Siwak, 2013). Students explore such questions as why homework doesn't get completed or how a book becomes a bestseller. Siwak's blog at http://www.heidisiwak.com is highly recommended reading because it provides a bird's eye view into teacher thinking and into students' learning processes.

In high school, the problem solving is student-centred. Avishai (2015) offers the example of Grade 12 students in a business leadership class. The students in the class acted as "consultants" and met with different teachers in their PLC groups to see what complex or wicked problems the teachers were experiencing in the school. In the Grade 12 class, one group of student consultants chose the problems around homophobia. They went through a four-part process. First, they constructed a two-sided dilemma, and structured the problem into its two opposable sides. The two choices seemed to be to either deliver anti-homophobia material in a large assembly or to a class for more individual learning. Second, the students considered the benefits of each option (and not the negatives). Third, they examined both models and reframed the problem to see that the core problem was actually the relationships in the school in general. The problem became "Why aren't students comfortable about sharing information about their cultures and lifestyles with each other?" Fourth, students explored possibilities to address this new problem. They recommended a set of assemblies with small breakout sessions for individuals and potluck lunches to encourage getting to know about the

richness of each other's cultures and orientations. The teachers were delighted with the reframing of the problem and diversity of its possible solutions.

Reflections on the Relationship of Disciplines to Integrated Approaches

Richards and Kroeger (2012) ask which approach is better for learning, and suggest the answer depends upon the educator's philosophical and epistemological beliefs. Those who believe that students can make connections and are capable of designing and implementing their curriculum are the teachers who would gravitate to student-centred problem solving approaches. Those who believe that the disciplines provide the best way of learning but also believe in interdisciplinary work would likely chose an approach grounded in the disciplines, a subject-centred approach. To us, it does appear that there is a time and place for disciplinary work, multidisciplinary/interdisciplinary work and also for work that transcends the disciplines.

We did not find much in the literature that related directly to transdisciplinarity at the K to 12 level. Given its increasing popularity at the university level, we expect then that the term will assume importance in the future. This is particularly true as educational jurisdictions around the world turn their attention to inquiry and problem solving as 21st Century skills. Collaborative problem solving, for example, is being assessed at OECD. Given the influence of international assessments done by OECD (for example, PISA), we predict that collaborative problem-solving will assume more importance in the schools.

Perhaps, a last word on the relationship of the subjects to integrated work comes from Rennie et al., (2012). In their case studies, they found that students who did disciplinary work did better in the disciplinary assessments than students who studied from an integrated approach. Students in integrated programs, however, did better in generic skills such as problem-solving than their counterparts. In other words, students achieved better in the areas they actually studied. Again what may be most important is to determine what is the intended goal and to match the teaching approach to it as Applebee et al. (2007) have advised.

To Integrate or Not to Integrate

There are many contradictory opinions about whether curriculum integration is a viable way to teach and learn. In this section we look at both sides of the argument. For some, integration comes at the expense of rigor and the dilution of disciplinary knowledge and skills – the way of thinking – of particular subjects. An issue that can arise is the lack of teacher expertise in subjects that are integrated (Brand & Triplett, 2012). This is a real issue that we will revisit in the Implementation section.

Lederman and Neiss (1998) expressed concern about a number of issues such as consistency of terms, conceptions of disciplines and disciplinary knowledge, diverse disciplinary conventions of evidence and the application of integrated curriculum to inquiry and real world problems. They conclude their editorial in the journal, *School Science and Mathematics*, the title an irony that does not escape them, with the following:

> We have no problem with attempts to organize instruction and curriculum in ways that combine numerous disciplines. We are not, however, in favor of approaches that attempt to ignore or dissolve disciplinary boundaries...We should be celebrating the diversity and integrity of the various disciplines, as well as the benefits of differing perspectives. In our opinion, *future attempts to elaborate and clarify the meaning of an "integrated" curriculum should abandon attempts to dissolve disciplines and create incongruous hybrids. Rather, a much more fruitful and reasonable approach would be to discriminate among varying levels of interconnections among existing disciplines. The focus of discussions should be around the number of disciplines and the degree of interactions within curriculum and instruction*. (italics in the original, p. 283-284)

Howes, Lim & Campos (2009) gave a measured endorsement to integrating literacy and science, but they did question whether science content was subservient to the development of reading skills, which were a focus of the NCLB testing agenda. As they put it, reading about animals to improve decoding skills is not the same as reading about animals to find answers to research questions. In reverse, when Simos (2014) as a literacy coach collaborated with a high school science teacher, students' science test scores improved.

A case in point: teaching traditional literacy. Literacy is often fused with other subjects. This integration is typical of "literacy across the curriculum" approach along with the adage that "every teacher should be a teacher of reading and writing". Draper (2008) proposed that reading should not be considered a standalone "subject", but rather should be used as a tool to provide access to other subject area content and concepts. Phillips, Bardsley, Bach, & Gibb-Brown (2009) and Casey (2013) describe the use of literacy to primarily enhance middle school mathematics achievement; Tews (2011) describes a multi-credit math, English and career and technical education high school program. Marcum-Dietrich et al. (2009), Sanders and Pavelski (2009) and Tong, Irby, Lara-Alecio, & Koch (2014) do the same for literacy and science. Thus, the integration of literacy (as opposed to literature) can be perceived as the effective booster or "servant" to improved performance in other areas.

At the same time, the importance of disciplinary distinctions has encouraged a more recent shift away from the application of generic literacy strategies. As a reaction to the 15-year stagnation of student achievement on the National Assessment of Educational Progress (the largest continuing assessment of what American students know and can do in core subjects), there has been a shift towards developing specific disciplinary literacy in which literacy tools serve the foregrounded discipline. For example, vocabulary is developed within a disciplinary context; forms of communication are shaped by the disciplinary context such as narrative in Language Arts, a report in Science. Infusing generic literacy strategies into subject content areas has not had the desired results (Alvermann, Achariya, Rezak, Boatright, & Jackson, 2011; Manderino & Wickens, 2014; Moje, 2008; Shanahan & Shanahan, 2008; Stock, Schillinger & Stock, 2014). Recognizing that every discipline has its own vocabulary and conventions, the curriculum reform expressed in the Common Core State Standards include disciplinary literacy standards specifically for history, science and technical subjects.

Similarly, the National Council of Teachers of English (NCTE) stated in its *Literacies of Disciplines* (2011) that the application of generic reading and writing strategies to various

content areas is ineffective in helping students to access the subjects' texts.

> Instead, instruction is most successful when teachers engage their students in thinking, reading, writing, speaking, listening, and interacting in discipline-specific ways, where literacies and content are not seen as opposites but rather as mutually supportive and inextricably linked. (p.2)

An emphasis on disciplinary literacy does not necessarily exclude interdisciplinary work. As with Boix-Mansilla and Gardner's (2008) advocacy for disciplinary thinking alongside interdisciplinary connections, Stock et al. (2014), write in favour of applying disciplinary literacy to interdisciplinary projects,

> … we are well aware that schoolwork that captures students' interest and imagination often takes shape in projects that are not only real or realistic but also meaningful to them. More often than not, such projects involve students in interdisciplinary studies, which—from our perspective as teachers of literacy—offer students rich opportunities to discover the value of the subject matter content and the literacy practices that different disciplines lend to the project work. It's been our experience that interdisciplinary projects also allow students to discover the differences between the bodies of knowledge and the literacy practices of different disciplines (p. 36).

The impact of accountability. The accountability movement with its emphasis on large-scale testing has raised concerns about a narrowing of the curriculum (Oreck, 2006; Trent & Riley, 2009), and its impact on integration.

Some do not see such accountability concerns as justified. Howes et al. (2009), for example, were relieved to find that the No Child Left Behind testing agenda did not threaten an inquiry-based science and literacy program. In an interview, Snow said that, "the exciting parts of the Common Core [is] the integration of reading and writing, the notion of cross-disciplinary projects" (Tucker, 2014). Snow is Professor of Education at Harvard Graduate School of Education and a member of the validation committee for the Common Core State Standards. Indeed, *Creating standards-based integrated curriculum: the Common Core Edition* (Drake, 2012) and *Less is more in elementary schools: Strategies for surviving in a high stakes environment* (Rubin, Abrego & Sutterby, 2015) shows how curriculum integration can be an effective way to meet these standards.

Many teachers find the sheer number of standards in official curriculum documents overwhelming. As of this writing, several jurisdictions are engaged in curriculum revision. A notable example is the development of the Common Core State Standards in the USA. As each discipline attempts to stake its claim for that most precious resource – instructional time - the standards expand to the point where it is unrealistic to expect teachers to actually address them all adequately, let alone substantially (Chrysostomou, 2004; Gresnigt, Taconis, van Keulen, Gravemeijer, & Baartman, 2014; Hurley, 2013; Russell-Bowie, 2009).

Tina Cheuk, a project manager for the Understanding Language initiative at Stanford University, did just that. In frustration, she looked over the Common Core State Standards in

English/language arts and math, along with the framework that would become the Next Generation Science Standards. She felt overwhelmed (Heitin, 2014). Cheuk noticed knowledge standards specific to each discipline, but also overlapping concepts, skills and learner attributes. She created a four-part Venn diagram to show specific disciplinary concepts, as well as duplication and connectedness. Thus, she eased her anxiety about curriculum coverage and laid a foundation for interdisciplinary curriculum planning.

In a standards-based world, integrated curriculum design can act as an efficient way to build coherence and reduce duplication (Hinde, 2005). Drake and Burns (2004), Drake (2007) and Drake et al. (2014) describe how to scan through the curriculum expectations of several subjects to identify those that are similar, and then to cluster them around enduring understandings (Big Ideas) and recurring cross-curricular skills such as communication and investigation. By integrating curriculum around the larger concepts expressed in overall expectations, teachers can be efficient in their planning and focused in their instruction.

Subjects that are not tested can face reduced instructional time and resources in favour of the tested academic subjects, particularly Language Arts and Math. Integrating with an academic discipline can be a way to foreground the non-tested disciplines and provide a richer learning experience for students beyond test scores. Teachers integrated physical education and literacy as a way to rescue physical education from obscurity because of a testing focus on literacy in a primary setting. The literacy program included reading materials about nutrition, sports and athletes to complement the physical education program (Fingon, 2011). Flinn and McInnis (2014) describe how middle school inquiry-based science classes integrated physical activity, which was part of the non-tested physical education program, with science. As it turned out, students improved their fitness levels and their science test scores.

Like physical education, arts educators can feel sidelined by current emphasis on core academic disciplines. Some arts educators fight for greater recognition and respect for their disciplines, and question the political and economic motives behind curriculum integration (Brewer, 2002). Winner (2001) provides a summary report of various studies exploring the impact of the arts on academic achievement in other subjects. She writes, perhaps in frustration, "Arts educators should never allow the arts to be justified wholly or even primarily in terms of what the arts can do for mathematics or reading. The arts must be justified in terms of what the arts can teach that no other subject can teach." (p. 1) and "Let's stop requiring more of the arts than of other subjects. The arts are the only school subjects that have been challenged to demonstrate transfer as a justification for their usefulness… The arts offer a way of thinking unavailable in other disciplines." (p. 3).

Other art educators take the position that "if you can't beat them, join them" through integration, usually resulting in benefits for student learning, behaviour and attitudes (Cosenza, 2005; Gullatt, 2008; Marshall, 2005; Moses, 2008; Nompula, 2012; Oreck, 2006; Viglione, 2009; Vitulli, Santoli & Fresne, 2013). Trent and Riley (2009) summarize the dilemma faced by arts educators, and recommend integration as its solution:

> We join others in asserting the arts have tremendous potential to impact schooling, and thus people and society, in ways we have only imagined. We are familiar with the

> essentialist argument: art should be in curriculum for valuable, art specific essentialist learning only vs. the instrumentalist argument: art can be used in curriculum to support learning in other school subject areas, as well as art learning…As practitioners with extensive teaching and administrative experience focused on public schooling (40+ years combined), we argue the instrumentalist approach can be implemented effectively in ways that support a "co-equal" integrative approach. In seeking a "co-equal" form of art integration, we target student outcomes (in our case district standards and benchmarks) in both art and other content areas. This co-equal approach, we believe, is the only feasible way for the arts to permeate regular classroom curricula in today's standards driven educational contexts. Essentialist approaches, we fear, will lead to further marginalization (and ultimately an absence?) of the arts in schools. (p.15)

Examples of integration of the arts with other disciplines abound. (See for example, Araki-Metcalfe, 2012; Cosenza, 2005; Edwards & Willis, 2000; Kakas, 2010; McNaughton, 2014).

Reflections on whether to integrate or not. Goodson (1987) notes in his collection of case studies and essays on curriculum that, "much of the curriculum debate can be interpreted in terms of conflict between subjects over status, resources and territory" (p. 3). It seems to us that some of this debate may be reflected in this section. As well, these arguments are largely conceptual ones, sometimes territorial in nature, and usually not based on any hard evidence of student success/nonsuccess. In the next section we review some of the research to better address the question of whether integration encourages effective learning.

Research on the Effectiveness of Integrated Approaches

In this section, we provide an overview of the research on the impact of integrated curriculum on learning. We reviewed over 200 articles that focused on personal experiences, theoretical perspectives or empirical research. We were aware of the caveats. Brewer (2002) reviewed 479 articles on arts and integrated curriculum and found that 82 percent of the literature reported on programs, 16 percent advanced a theory or rationale, and less than 2 percent focused on research. Hurley (2001) undertook a review of integrated curriculum in databases and print indexes over the twentieth century. She identified 83 studies on the impact of integrated curriculum on academic achievement in math and science. Only 31 fit the initial criteria for comparability, and even they were so diverse that her study concluded that a generalized reliable judgment on the efficacy of integrated curriculum on achievement could not be made.

We also knew that much of the literature consisted of positive stories told by enthusiastic practitioners - characterized as testimonials (Czerniak et al., 1999). Some of the literature relates negative experiences or perceptions and is cautionary. Applebee et al. (2007) call this "advocacy literature, arguing pro or con based on the experiences of individual teachers or schools" (p. 1003). Many educators provide testimonials about the effectiveness of units they have taught, and many professional organizations stress integration across the curriculum. For some, testimonials and accumulated qualitative data and case studies are enough to make positive observations.

For this review we sought solid evidence. As Pang and Good (2000) say, the lack of reliable empirical research has meant a need for caution in support of integration. However, the advent of

large- scale testing and standardized testing has also changed the landscape of research on integrated curriculum.

For the first time, we have examples of integrated curriculum implementations where data have been collected and, for example, student scores are used as evidence. Although, some researchers claim that one cannot adequately measure the kind of results that can be achieved by integrated approaches with quantitative data (see, for example, Rennie et al., 2012), we welcome this new data. We believe that a solid database is being built to deepen understanding about integrated curriculum.

One challenge is that the literature rarely uses the keywords "integrated curriculum", much less multidisciplinary, interdisciplinary or transdisciplinary, but, as previously mentioned, integrated programs are reported in other guises such as project-based learning, arts integration, expeditionary learning, SEL(socio-emotional learning), place-based learning, gifted education, democratic schools, science, technology, science and the environment, STEAM and ST2REAM, and under programs such as the Big Picture Schools and Expeditionary Learning Schools.

For this part of the review, we highlight articles that we judged as being substantive research; that is, there was a well thought-out research methodology, data were collected and analyzed. We have created subtitles to represent categories, but found that the boundaries of the categories were very fluid.

Historical background.

In 1900, Dewey said, "Relate the school to life and all studies are of necessity correlated" (p. 91). Integrated curriculum has a long history linking it to the progressive movement in education (Beane, 1991; Klein, 1990; Vars, 1991; Wrightstone, 1935). The progressive movement was grounded in the work of John Dewey at the Chicago Experimental School in the early twentieth century and his ideas of 'organic' education, experiential learning and the 'community-centred' curriculum (Dewey, 1997/1965/1938). A hallmark of the progressive movement was the project method (Kilpatrick, 1918); this method was a student-centred inquiry that culminated with a presentation and was similar to project-based learning in the 21st Century. These were the roots for constructivist learning, an approach that is very much in the forefront today. Two studies from this period are important to consider.

In the 1930s, an integrated approach to learning was generally accepted by most as suitable at the primary level. But the general notion was that students needed a disciplinary education by Grade 4, as it was a better way to learn. Wrightstone (1935) challenged this view. He looked at 180 students who went to either a traditional subject-based school or a progressive school with a unified curriculum from Grades 4 to 6. Students were matched in intelligence quotients, SES backgrounds and chronological age. Teachers had the same experience and training at both the traditional and progressive sites. On the achievement tests in reading, language and arithmetic, "the pupils in the new type schools were slightly superior in achievement to the pupils in the standard-type schools" (p. 586) although the results were not statistically significant. The new-type schools spent much less time on mastery, drills and remediation, yet students achieved as

well as their counterparts. For Wrightstone (1935), this study suggested that students in Grades 4 to 6 were not hampered by an integrated approach to learning.

The Eight Year Study "still stands today as the most comprehensive, long-range, experimental educational research study ever conducted in school settings, and its lessons are many and as pertinent today as they ever were" (Lipka et al., 1998, p. 1). Curriculum scholar Pinar (2010) agrees, "this remarkable undertaking remains today as perhaps the major school-based curriculum research project in the history of U.S. curriculum studies" (p. 295). The study wished to challenge the opinion that a non-traditional program would not prepare students for university. It also aimed to encourage greater curriculum coherence, democratic communities for students and teachers, and innovative programming that was responsive to student needs (Kridel & Bollough, 2007).

The study began in the 1930s in thirty secondary schools across United States (Aikin, 1942) and was led by esteemed progressive educators such as Ralph Tyler. The rationale for the study was that secondary schools were not working. Schools had no clear-cut, definite, central purpose and failed to create conditions necessary for effective learning. The study was sponsored by the Progressive Education Association (PEA) and funded by the General Education Board of the Rockefeller Foundation.

The schools in the Eight Year Study were to follow two principles: 1) Teachers were to apply the teaching and learning principles as represented by the progressive movement. The lessons needed to be personally meaningful and involve the whole person. 2) Students needed to learn the skills to be citizens in a democratic society. Schools were given the opportunity to redesign curriculum from subject-based to integrated core curriculum. Teachers were given the opportunity to create resource units in a 6-week summer institute working with members of the Peabody commission. Resource units were intended to make the learning context more flexible. Learning was considered to be a series of experiences that balanced student interests with social and educational needs and was evidenced in core curricula, resource units and teacher –pupil planning.

Contrary to some understandings of the Eight Year Study, assessment and evaluation of student success was an important part of this study. Extensive student testing occurred with sophisticated tests and inventories to assess knowledge, skills beliefs and values (Kridel, 2010). Psychoanalysis was used as a form of professional development (some of the practitioners were closely connected to Sigmund Freud). Staff and teachers would present student cases using cumulative student records as a way for participants to reflect upon their fundamental educational beliefs.

A follow-up study investigated how these students fared in universities. Universities dropped their admission procedures for students from the Thirty Schools. Students entered 179 colleges and 1475 matched pairs (in the study and not in the study) were measured on 18 variables. The results showed that students from the 30 schools performed as well as, or better than, their counterparts in the comparison group. This result held for every measure of scholastic competence (e.g., GPA, academic honours). They did better in developmental aspects such as

time management, resourcefulness, problem solving, degree of intellectual curiosity, drive, and active concern for what was going on in the world.

Kridel and Bollough (2007) did a critique of the schools in the study and claim that many of the 30 schools did not actually make substantive changes to the curriculum or embrace the spirit of the study. As well, some of the students who were followed were the wrong students and not really in the target study group. In reality, there were six schools that followed progressive principles and employed integrated curriculum. These six schools practiced teacher-student planning and created learning experiences that balanced student needs with social and education ones. This observation makes an important difference to how the study should be interpreted.

> Recognizing that great variation existed among the participating schools, the Aikin Commission initiated the study within the study where 323 students' college records from the six most experimental schools were examined and compared with student records from traditional school matchees and to students from the other Eight Year Study participating schools. These students substantially outperformed their peers on virtually all measures of college success, suggesting that schools could experiment with curriculum design without jeopardizing the future academic success of their graduates (Kridel, 2010).

Aikin (1942) writing at the time of the study concurs: As well, the graduates of the schools with the most experimental programs (interdisciplinary was an important characteristic) were "strikingly more successful" (p. 113) than their matches and all other schools in the study.

These two studies from the 1930s indicate that students did not suffer from being taught from integrated approaches and, in fact, may have done better than being taught in a traditional program. This is a theme that was to be echoed again over the next 85 years.

From the progressive movement in the 1930s until the late 1980s and early 1990s, there were some notable integrated curriculum efforts such as the middle school 'core' approach and the 'aims and generalizations' approach of Caswell's Virginia Curriculum Revision Program (Kliebard, 1995). In 1931, Caswell began a statewide curriculum reform initiative that he hoped would lead to more efficient use of resources and the creation of a better society in the state of Virginia. What he introduced was the use of a chart, which planned and created curriculum on a matrix. On the vertical axis of the matrix was "scope", which Caswell defined as a series of social functions, and on the horizontal axis were organizing themes based on teacher-perceived student interests (Kliebard, 1995). In this program, the disciplines were replaced by the social functions, which were cultural values and aspects of everyday life that Caswell thought were important for students to adopt. Teachers were then organized into "study committees" in which they actively participated in creating curriculum using Caswell's matrix (Kliebard, 1995). Judging by the voluntary participation of elementary and secondary teachers in Virginia - as approximately 15,000 of the 17,000 teachers in the state participated in the Program (Kliebard, 1995) - teachers felt empowered by this new way of designing curriculum. Similar large-scale curriculum projects were begun in Arkansas, Georgia, Kentucky, Tennessee and Texas throughout the 1930s (Wraga, 1997). By 1937, the state of Virginia, using surveys of teachers and parents in addition to measures of academic achievement, reported that the new elementary

course of study was a “great improvement" over the discipline-based curriculum used previously. Additionally, the state reported that 85% of teachers in Virginia were using at least part of the Program in their classrooms (Kliebard, 1995). The high school program, however, did not see the same results, which Caswell blamed on the resistance of high school teachers to change their identities from subject specialists to core teachers. Despite this, Caswell’s Program was the basis of the curriculum in the state of Virginia from 1932 to 1952 (Kliebard, 1995). What is most important about the Virginia Curriculum Revision Project, however, is that it was the first example of the multidisciplinary/interdisciplinary model of curriculum integration to be used on a large scale (Dowden, 2007).

As the 20th century progressed, integrated curriculum approaches featured team teaching, interdisciplinary curriculum, block scheduling, and student activities (Vars, 1991). In the 1980s, the Carnegie Report (1989) and the California State Department of Education Report (1987) reported that middle school students were not motivated to learn in the traditional discipline-based system. In response, a proliferation of “new” integrated curriculum models emerged. Indeed, Volume 49, Issue 2, 1991 of *Education Leadership*, a journal widely read by educators across North America, was devoted entirely to this topic. Many jurisdictions experimented with different ways to integrate the curriculum.

One of the most important studies of the time was the Humanitas project (Aschbacher, 1991). Humanitas is an interdisciplinary program that is theme-based and uses a team approach to teaching humanities. An assumption of this program is that all students can succeed with a conceptual approach. Humanitas provides opportunities for critical thinking, writing and discussion skills. Teacher collaboration is the heart of the program.

A complex evaluation of Humanitas was undertaken by the UCLA’s Center for the Study of Evaluation. Students in 16 schools in Grades 10, 11 and 12 participating in the Humanitas class were compared with students in traditional programs. Performance based-assessments on approximately 500 students, surveys, statistical analyses and student attendance records were used. The researchers found that Humanitas students made their largest gains on conceptual understanding compared to their counterparts who made little improvement. As well, Humanitas students conducted richer discussions, participated more in the discussions and reported liking school better, even though they believed that they had to work harder than students in regular programs. When Humanitas students were looked at individually, the program had a statistically significant effect on students’ writing and content knowledge over a year. The longer the students stayed in Humanitas, the better their writing and content knowledge performance, overall school attendance, and the lower their dropout rate.

Another study with a strong research base was the thematic science-centered curriculum implemented in elementary schools (Greene, 1991; Kovalik & Olsen, 2010). In the first year, 60 teachers in 11 schools joined the initiative. The project was grounded in the fundamentals of the MCSIP (Mid-California Science Improvement Program) and was based on Susan Kovalik’s (1986) integrated thematic model. The purpose was to improve science education by teaching a thematic unit where “science is the ingredient that unites all other subjects” (p. 43). Two examples of themes are “A Shovel Full of Dirt” and “California, the Edge and Magic, Marbles and Motors: The Many Faces of Motion”. Students read and wrote about science, investigated

and solved problems, did measurement and computation. They used the arts to communicate their understanding. The program was evaluated by Stanford University School of Education for student achievement in science, and for students' and teachers' attitudes. Student achievement in science "showed substantially and statistically significant gains" (p. 44). The curriculum was successful with both disadvantaged and gifted students. Language barriers were not a problem. Most teachers had an increased comfort with teaching science and had shifted from fear to showing openness and enthusiasm.

Lake (2000) reviewed 53 documents on curriculum integration from this period. Although she noted the same difficulties with the literature as noted previously, the results supported positive effects of integration. There was no detrimental effect on learning in either elementary or secondary schools. Students reported that they liked school better; they stayed in school longer and demonstrated higher achievement scores in some areas.

Vars and Beane (2001) sum up the research of the 1980s and 1990s:

> However, recent analyses of studies (Vars, 1996, 1997; Arhar, 1997; National Association for Core Curriculum, 2000) point to the same general conclusion: **Almost without exception, students in any type of interdisciplinary or integrative curriculum do as well as, and often better than, students in a conventional departmentalized program. These results hold whether the combined curriculum is taught by one teacher in a self-contained or block-time class or by an interdisciplinary team.** (http://www.ericdigests.org/2001-1/curriculum.html) (emphasis through bold font added)

Despite these successes, integrated approaches had come to a standstill by the mid-1990s; educational systems had swung to accountability, standards-based curriculum and standardized testing.

The current context. As we move deeper into the second decade of the 21st Century, integrated approaches are again receiving favourable reviews in practice, jurisdictional policy and the literature. We look at these through the lens of case studies of a one school or project, integrated programs that schools can adopt and implement, and finally whole school programs that involve a network of schools.

Case studies More recent studies also support the positive impact of integrated curriculum on student learning. Most of these involve one school or on project in a school and are time limited. Vega (2013a) completed an evidence-based literature review on integrated studies summarized in an annotated bibliography (Vega, 2013b). She found that, when compared to traditional instructional methods, effective practice and programs in integrated studies can improve multiple indicators:

- Participation, motivation, and interest in learning (Catterall, Dumais, and Hampden-Thompson, 2012; Goldschmidt and Jung, 2010; Guthrie, Klauda, and Ho, 2013; Hughes, Bailey, and Karp, 2002; Mac Iver, 1990; Smithrim and Upitis, 2005; Upitis, 2011)

- Critical-thinking and problem-solving skills (Billig, 2010; Furco, 2010)
- Academic achievement (Barry, 2010; Blair, 2009; Borman, Hewes, Overman, & Brown, 2003; Catterall et al., 2012; Cervetti, Pearson, Barber, Hiebert, & Bravo, 2007; Furco & Root, 2010; Goldschmidt & Jung, 2010; Guthrie et al., 2013; Klemmer, Waliczek, & Zajicek, 2005; Nelson, 2001; Hendrickson & Oklahoma A+ Schools, 2010; Romance & Vitale, 2012a, 2012b; Satchwell & Loepp, 2002; Smith & Motsenbocker, 2005; Smithrim & Upitis, 2005; Walker, McFadden, Tabone, & Finkelstein, 2011; WestEd, n.d.)
- Attendance, graduation, and college attainment rates (Catterall et al., 2012; Furco, 2010; Hughes et al., 2002)
- Feelings of connection among teachers and team spirit among students (Mac Iver, 1990; Smithrim & Upitis, 2005)

The studies mentioned above are summarized in an annotated bibliography (Vega, 2013b).

Barr et al. (2015) describe the results of a randomized controlled trial assessing the impact of a five-day seminar designed to help humanities teachers effectively integrate civic education into their history courses using a student-centred approach. Students who participated in the integrated unit outperformed control students on a measure of historical understanding.

For three years, Cordogan and Stanciak (2000) tracked American students in a high school program that integrated English, algebra, biology and history. They found that students in the interdisciplinary program (a school within a school) had lower absentee and suspension rates than the students in the regular disciplinary program, and that the interdisciplinary students' scores were equal to, or higher than, their disciplinary program counterparts on the Iowa Test of Educational Development.

Halvorsen et al. (2014) found that low SES Grade 2 students performed as well as their higher-SES counterparts when project-based units integrating social studies and literacy were implemented, although pre-integration, the lower SES group had not been as successful. A comparative study of American preschool Head Start programs (Fantuzzo, Gadsden & McDermott, 2011) found that students in the program that integrated mathematics, language and literacy demonstrated greater growth in mathematics and listening comprehension than students in the "stand alone" program, although both programs produced significant growth rates in literacy.

The Food, Math, and Science Teaching Enhancement Resource (FoodMASTER) is a program that uses food as a tool to teach mathematics and science. Hovland et al. (2013) assessed its impact on increasing the food-related multidisciplinary science knowledge of 4th graders in North Carolina. On pretests, there was no significant difference between the control groups (16 classes) and the FoodMASTER groups (18 classes), but on the post-test, there was a significant difference in favour of the FoodMASTER group. The researchers concluded: "These findings

suggest the FoodMASTER intermediate curriculum is more effective than a standard science curriculum in increasing students' multidisciplinary science knowledge related to food" (p. 8)

MacMath, Roberts, Wallace, and Chi (2010) followed 23 at-risk students in Ontario as the students went through an integrated program in science and geography. The theme of the integrated unit was energy conservation and problem-solving. Observation was focused on seven pre-selected students. A mixed method approach was used for the research including both quantitative and qualitative methods. To counteract feelings of learned helplessness, the two teachers hoped the students would gain a sense of self-efficacy. The teachers wanted to make the curriculum meaningful to the students and to help them make new connections between subject areas. For both subject areas, student performance on end-of-unit assessments exceeded teacher expectations. Students experienced greater academic success due to repetition and reinforcement of content across contexts in the different classrooms. This success contributed to a greater sense of self-efficacy, noted by the researchers as, "when students were able to use what they had learned in one classroom to answer questions and make connections in another classroom" (p. 93). Students perceived their success as being connected to their own hard work. Finally, the researchers found that students were more motivated in this unit compared to previous subject-specific units. "By moving beyond a single discipline, both teachers and students felt their problem-solving activities mirrored problems encountered outside of the classroom" (p. 93). The researchers believe that these results are important for future work with at-risk students.

Organizations. There are organizations promoting integrated learning in various forms. The Curriculum Project developed by Curry and Samara (http://www.curriculumproject.com) offers the Curry/Samara model (CSM) and the Models Classroom Project to schools K to 12. Their work is described as integrated standards-based curriculum. CSM differentiates for three dimensions (content, process and product). Implementation includes six categories of content, thinking, product, assessment, facilitation and reflection. They focus on content that moves from factual to global concepts. Curry and Samara are a private company that have been providing in-service for teachers since 1985. Evidence for their success in many areas including academic can be found at http://www.curriculumproject.com/knowledge_share_scholarly_reports.php.

The iEarn (International Education Resource Network) is the largest non-profit global network in the world that boasts 140 country members, 30 languages, 50,000 educators and 2 million youth. Here students and educators connect online or sometimes in person at annual conferences. The organization offers a number of projects that any teacher can join with his or her class. The projects promote integrated curriculum and constructivist learning. For example, students from Rowena Gerber's Grade 4 class in Florida built solar ovens from shoeboxes, pizza boxes, tires, lampshades and other objects, and lined them with tin foil (Drake, 2012). They played the roles of scientists, journalists, scriptwriters, and business people to learn how to make the most efficient ovens. They video-conferenced with their solar cooking partners in Australia, Haiti, Senegal, Dubai, South Africa, Hong Kong and Ontario and had live cooking demonstrations. They also raised money for real solar ovens to be sent to Afghanistan, Haiti and Sierra Leone. Partnering with a Rotary Club that matched funds, they raised $40,000.000 by growing 35 edible garden and selling plants and herbal oils and vinegars and salsa that they made. They sent 20 family-sized ovens to Senegal. An oven could cook 500 loaves of bread in an hour and 1200

meals twice daily. Students in Florida and Senegal celebrated through dancing and drum playing by videoconference.

Although most of the iEarn organization appears to be more about doing than documenting their effectiveness, there is some research that supports this approach. For example, in Brazil all students improved in reading, writing and word comprehension in English when involved in an iEarn project (Garibaldi, 2004). When students in Moscow, China and New York City connected, there was improved intercultural awareness (Bush, Chung, Holton, Kokozos, 2007). An annotated bibliography of available research can be found at http://www.iearn.org/impact/research-and-evaluation.

Project-based learning (PBL) often employs an integrated approach. Here student learning begins with a driving question and culminates after substantive exploration with a "project" that addresses the question. The approach is constructivist and student-centred. PBL learning exists in many guises; the Buck Institute for Education (www.bie.org) is dedicated to promoting this kind of learning. Edutopia (http://www.edutopia.org/) is also an excellent site to gain a deeper understanding of PBL. Vega (2012a) offers several examples of research-supported PBL. A review by Holm (2011) provides an overview of the research.

Studies conducted over the last ten years confirm earlier, generally positive findings (Barron et al., 1998; Thomas, 2000) regarding the efficacy of project-based instruction. Project-based instruction prekindergarten through 12th grade has yielded improved content learning, higher levels of engagement and more positive perceptions of the subject matter. With such a clear research base in support of its effectiveness, project-based methods appear to offer the possibility of success both overall and to a broader range of students than traditional lecture-based instruction. Research clearly indicates that project-based learning is beneficial, with positive outcomes including increases in level of student engagement, heightened interest in content, more robust development of problem-solving strategies, and greater depth of learning and transfer of skills to new situations (Hmelo-Silver, Duncan, & Chin, 2007; Thomas, 2000).

STEM and a variety of science programs also move into integrated territory. STEM integrates science, technology, engineering and math. The program involves hands-on project-based activities. Research suggests that STEM students show improved attendance and improved math and science achievement (Satchwell & Loepp, 2002). Describing an innovative STEM school in Cleveland, for example, the most disadvantaged students did well in an interdisciplinary PBL with a real world application. Their students did better in reading, writing, math, science, and social studies with a high school graduation rate well above the average for other students in the state of Ohio (Vega, 2012b).

Integrating science and literacy is also effective (Vega, 2013b). Seeds of Science/Roots of Reading , Science IDEAS and Concept-Oriented Reading Instruction all fall within this category. Research shows that students demonstrate greater skills in both literacy and science (Cervetti et al., 2007; Romance & Vitale, 2012b). Another direction for innovation has been to turn STEM to STEAM. This acronym means to integrate the arts into science, technology, engineering and math. There are many websites offering examples of engaging ways to do this. Presumably

STEAM would have the same benefits as arts-education and STEM do (see, for example, Miller 2014; Riley, 2013).

Network of Schools. There are some "programs" that involve many schools and a systematic plan to integrate the curriculum.

At Big Picture schools, the motto is to educate one student at a time. The content of study is personalized and students explore their area of interest in a real world context. By its very nature, the program is integrated given the real world is not segregated in disciplines. Begun at one school in Rhode Island in 1995 by Dennis Littky and Elliot Washor, today there are 60 American schools who have adopted this approach, 25 Australian, one Canadian and 13 in the Netherlands. There are high graduation rates (92%) and university acceptance rates (95%) (www.bigpicture.org). This is a non-profit organization dedicated to equity, urban students and disrupting the traditional model of education.

In 1991, Outward Bound and the Harvard School of Education collaborated to win a grant for Expeditionary Learning. This type of learning includes project-based learning, case studies, academic learning expeditions, and service learning. Today there are 160 Expeditionary Learning Schools (ELS) involved in 33 states in the USA and thousands of teachers who access their learning resources. A study in 2003 indicated a significantly positive effect on student achievement. There has been a positive impact on student learning across schools in multiple states (Borman, Hewes, Overman & Brown, 2003). The Expeditionary Learning website indicates 100% college acceptance and "our schools consistently outperform their peers on academic achievement measures and we are committed to collecting third party research on the impact of our work" (http://elschools.org/our-results).

In 2003, Asia Society for International Studies launched a network of 34 schools across United States known as International Studies School Network (ISSN). The goal of the schools in this network is for students to be college and career ready and to develop the global competencies. Professional development is provided by the Asia Society. Students can study more than on language. These students are educated to investigate the world, weigh perspective, communicate ideas and take action. Students come from predominantly economically disadvantaged backgrounds, yet 92% graduate on time and 90% go on to college (Vega, 2012c). Research shows that the students academically outperform students in other schools (http:// society.org/international-studies-schools-network).

By far the most comprehensive program that we discovered is the International Baccalaureate**.** The PYP and MYP programs of the International Baccalaureate encourage cross-curricular projects and subject integration. Primary programs are described as transdisciplinary. Various studies indicate that IB students in these programs perform very well academically in relation to non-IB students. A study undertaken by Tan and Bibby (2010) on behalf of the Australian Council for Educational Research (ACER) compared the performance on the International Schools' Assessment (ISA) of 23,575 PYP and MYP IB students to 14,317 non-IB students across Asia and Oceana, Europe, Africa and the Americas. The study found that generally, IB students outperformed their non-IB peers on the ISA in math literacy, reading, narrative writing and expository writing at most grade levels. In a follow-up study, Tan and Bibby's analysis

(2012) of PYP and MYP students' performance on the ISA came up with similar results. In a case study set in Texas, USA (Sillisano et al., 2010), 43 IB schools with PYP and MYP programs were matched to non-IB schools in order to compare performance on standardized state reading and math tests. The study concluded that IB schools performed as well as their comparison schools on the Texas Assessment of Knowledge and Skills exam. A study conducted to assess how well Australian PYP students performed on the 2012 National Sample Assessment in Science Literacy (NAP-SL) found that for 48 of the 49 questions in the NAP-SL test, PYP students outperformed the national average (Campbell, Chittleborough, Jobling, Tytler, & Doig, 2013).

Student achievement in the affective domain. Judging the effectiveness of integrated curriculum by looking at academic achievement and test scores alone is an oversimplification of the goals that usually motivate its implementation. As Applebee, Langer, Nystrand and Gamoran (2003) point out, educators who choose to teach an integrated program usually have a philosophical stance towards learning that encompasses a suite of student-centred practices fostering engagement, collaboration and student choice.

Frequently, studies that consider the benefits of integrated curriculum are not investigating measurement data such as test scores of subject-content knowledge. Rather, they focus on learner traits such as the development of thinking skills, improved behaviour or self-regulation, prosocial attitudes, emotional health, creativity and motivation. Such claims are prevalent in endorsements of integrating the arts with other subjects. (See for example, Araki-Metcalfe, 2012; Cosenza, 2005; Edwards & Willis, 2000; Kakas, 2010; Marshall, 2005; McNaughton, 2014; Russell-Bowie, 2009; Trent & Riley, 2009; Viglione, 2009). On the other hand, there are rigorous studies of arts integration that show increased academic achievement and engagement from both high and low SES backgrounds (Caterall, Dumais, & Hampden-Thompson, 2012; Upitis, 2011; Vega, 2012;Walker, McFadden, Tabone & Finklestein, 2011).

Socio-emotional learning (SEL) is learning that includes self-awareness, self-management, social awareness, relationship skills with others and responsible decision-making (Vega, 2012d). Vega (2012e) looks at evidence for popular evidence-based SEL programs: Responsive Classroom Approach, Second Step, 4 Rs Reading, Writing, Respect, Resolution, Resolving Conflict Creatively Program, Meditation, Service Learning, and School-wide Positive Behavior Report. The evidence for each program demonstrates a strong link between enhanced social emotional skills and academic performance.

Vega, (2012f) offers a rich annotated bibliography on this body of research. For example, four elementary international schools in Seattle were teaching a global curriculum (Vega & Terada, 2012). To support students in developing skills in communication and recognizing perspectives, they used two related research-based social and emotional learning curricula programs: Second Step (http://www.cfchildren.org/second-step) for K to 2 and Steps to Respect for Grades 3 to 5. Students were able to show empathy. As well, they developed their impulse control skills, anger-management techniques and solving problems. In addition,

> [a] meta-analysis of 213 programs, primarily covering three decades of research, found that social and emotional learning interventions that address the competencies listed

> above increased students' academic performance by 11 percentile points, as compared to students who did not participate in such SEL programs (Durlak et al., 2011). The social and emotional learning programs also reduced aggression and emotional distress among students, increased helping behaviors in school, and improved positive attitudes toward self and others (Durlak et al., 2011). Effective SEL programs addressed the five key competencies listed above, explicitly and sequentially, and used active-learning techniques to engage youth in developing understanding of them (Vega, 2012a).

The study described above implies that interdisciplinary and transdisciplinary curricula may be particularly suited to International Baccalaureate programmes. The IB Learner Profile is explicit in its description of desirable learner attributes, many of which fall into the affective domain – "open-minded", "caring", "risk takers", "balanced", "reflective" for example, "The profile enables teachers to make programme-relevant decisions about the dispositions and habits of mind to be nurtured through disciplinary and interdisciplinary instruction" (Boix-Mansilla, 2010, p. 3). For The International Baccalaureate Organization, transdisciplinary curriculum is an important way to achieve its overarching goal:

> …the cultivation of internationally minded, independent learners who can make meaningful connections across school subjects and in the world outside the classroom. It seeks to nurture students' capacity to engage in and employ multiple sources of expertise to solve problems, create products, produce explanations and raise new questions about the world in which they live. (Boix-Mansilla, 2010, p. 3).

A case study of the PYP in India indicated that PYP students demonstrated high levels of emotional intelligence (Pushpanadham, 2013), while Tan and Bibby's (2012) analysis of the Student Learning and Wellbeing Questionnaire found that PYP IB students, compared to non-IB peers across five geographic regions, showed a moderately higher degree on student- teacher interaction, social connectedness, personal development and academic engagement. (These differences diminish in grades two years older.) Structured classroom observations and interviews included in the Texas case study described above (Sillisano et al., 2010) led the researchers to say that that the PYP and MYP programs encourage motivation, the application of critical thinking skills and the development of global and cultural awareness.

Student endorsements tend to highlight the affective domain – growth in self-confidence and self-awareness, forming positive relationships, recognizing their place in their communities. These are also the characteristics that make experiential learning meaningful, and there are parallels in philosophy and outcomes among integrated curriculum and service learning and co-operative learning programs (Michigan Service Learning, 2005). Carmichael (2015) found that when students who had participated in a full day, four and a half month integrated program looked back a decade later, they reported that their experiences had had a profound effect on their choice of future profession and on their personal and social skills. Although they did not remember much about the course content, the students did remember the sense of community that they felt, and many reported still being good friends with classmates.

Increased student engagement. Student engagement is often cited as the first reason to implement integrated curriculum, and indeed, feedback provided in case studies indicates that

integrated curriculum does resonate powerfully with students (Betteley & Lee, 2009; Kruse, 2001; Marcum-Dietrich et al., 2009; Nathan, 2008; Russell & Burton, 2000; Sanders & Pavelski, 2009).

Much of the literature on academic achievement also includes student engagement (academic improvement and student engagement seem to go hand in hand). As pointed out in Holm's (2011) review of the literature on PBL above, students improved academically and had increased student engagement. Here we look more specifically at teacher voices on their experiences with student engagement.

Araki-Metcalfe (2012) provides a teacher's comment about a disengaged Year 6 boy who participated in a unit that integrated drama and English-language learning:

> What surprised me most was that one of my students, who never showed any interest in learning and slept all the time in class, was actually participating in the drama-EFL classes. I saw him asking questions to other students…and he also participated in designing the robot. His performance as an old robot engineer was fantastic and he even introduced himself in English" (p.72).

A Grade 7 teacher (Clark, 2011) described the impact of an interdisciplinary unit that included a student-centred inquiry into the impact of cars: "We had begun the connection- making. Over the next several weeks, the dumbfounded faces were replaced with eager expressions and waving hands crying to be recognized. Why? Because education was relevant and connected to our students' lives." Another teacher involved in the same project noted "only three students out of 125 are chronically choosing to do poor work — far less than in other years." (p.44)

The Bronte Creek Project (www.brontecreekproject.org) is a full-day integrated outdoor education program in Southern Ontario. Here is how one participant described her learning: "I have learned so much information over the past semester. I think my parents are getting tired of me always having a fact or statistic that I learned in school that day that I wanted to wow'em with!"

Integrated curriculum provides relevancy because connections are made more explicitly and holistically to the students' own lives. As Beane (1991) says:

> real curriculum integration occurs when students themselves confront personally meaningful questions and engage in experiences related to those questions – experiences they can integrate into their own system of meaning. (p. 9).

As we look back on this review and the history of student achievement in integrated curriculum, we see a distinct pattern. Hinde (2005) sums it up:

> The bottom line on the research concerning the efficacy of an interdisciplinary approach to curriculum is that when skilled, knowledgeable teachers employ integrated methods, student achievement is equal to, or better than, that of students who are taught in the traditional separate-subject approach. Therefore, integrating the curriculum is a powerful

> and useful pedagogical tool when it is employed with much preparation and thought. It is clear from the research that student achievement hinges on the teacher's ability to integrate content across disciplines effectively in meaningful ways. For integration to be effective, teachers must have adequate knowledge about the content areas they are integrating, and they must have adequate training in integrative techniques. Furthermore, even though integration has proven to be effective in engaging students and increasing their achievement on standardized tests and other measures of achievement, there are some caveats that teachers and curriculum developers must consider (p. 107).

Reflections on the Effectiveness of Integrated Curriculum

In tracing the history of integrated curriculum in Ontario, Clausen and Drake (2010) discovered a pendulum effect over time. There were times when the province adopted strong policies that promoted a holistic approach to education with integrated curriculum being an integral part. At some point there was a hue and cry from the public that it did not know how the students were doing and that a return to the basics was needed to insure accountability. Policy then shifted back to the traditional approach. The traditional approach would dominate until the public believed that students were not sufficiently engaged and that the curriculum needed to be relevant and meaningful. Hence a return to integrated curriculum. This same pendulum pattern can be seen in the literature review with particular emphasis on integrated approaches in the 1930s, and the late 1980s and early 1990s. Circa 2015, we believe the pendulum is beginning another swing toward integration for 21st Century learning.

Research sends a clear message that students achieve as well academically, or better than those in traditional programs. In addition, students in integrated programs are more engaged, attend classes more often, and report being more motivated. As we shall see later, teachers are energized when they teach this way. Nevertheless, some educators seem to resist this approach. Why does this happen? We explore the global perspective of one of the main tensions in the educational community – accountability versus an engaging relevant curriculum.

Negotiating Accountability and Integrated Learning from a Global Perspective

In this section we explore the relationships among integrated curriculum, student achievement and educational policy at the national/provincial levels. The policies of East Asian countries, Finland, the province of Quebec, Canada and the IB schools are explored as they have much in common.

The tension between the need for accountability and the need to create an educational system that works in the 21st Century permeates educational jurisdictions around the world. Curriculum integration is a part of that tension. Although there was a strong interest in curriculum integration in the late 1980s and early 1990s in Unites States and Canada, the push toward standardization and large-scale testing muted that interest (March & Willis, 2007). The thinking seems to be that in order to do better on accountability measures, there is no room for integrated approaches. On the other hand, since 2000 the jurisdictions in East Asia have been attracted to integration as a means of developing generic skills, expand international awareness and prepare students for a global economy (Lam et al., 2013). Yet, the stereotype of East Asian

countries is that the students study endlessly in a highly competitive, ruthless environment to obtain the top spots at the next level of schooling.

We wondered about the relationship between curriculum policy on integrated learning and countries that consistently do well on international accountability measures – specifically PISA. Our "hypothesis" was that if countries that do well in PISA also include integrated learning, then this should be an endorsement for integrated learning. Although it is obviously simplistic to consider testing as the only obstacle to reform, we explore here how countries such as, Hong Kong, Shanghai, Singapore, Korea and Japan that repeatedly top the OECD charts are dealing with education in the 21st century. We then look at Finland, Quebec Canada and the IB Schools. This is followed by a brief discussion of educational policy in the United States and Ontario, Canada in the hope of gaining a deeper understanding of the issue.

East Asia

China. China as represented by Shanghai and Hong Kong has continually topped the charts in international testing. Indeed, in 2015, OECD education director Andreas Schleicher commented that Shanghai pupils' performance in the basic skills is now so good that it is beyond comparison with any other country (Garner, 2015). It is important to note that Shanghai and Hong Kong can provide a very powerful window into education into China, but may not be representative of all parts of such a diverse country. Indeed, Shanghai and Hong Kong are both different in their approaches given their very different histories.

In both Shanghai and Hong Kong, there is a forward thinking mindset with "a clear awareness that education needs to transform to keep pace with the rate of change in society – and not just current change, but a conscious effort has been made to take into account the future of society, the economy, and education" (Singmaster, n.d.; http://asiasociety.org/shanghai-worlds-best-school-system). A brief look at their policies sheds some light on integrated approaches.

Hong Kong offered a unifying framework K to 12 that called for integration in 2001. "Both integrated learning experiences and discipline-based studies are valuable for students. Therefore, students should be given opportunities to study both" (Curriculum Development Council Hong Kong, 2001, p.26). This framework is presented as a graphic in Figure 3. In 2001, The Key Learning Areas (KLA) replaced subject areas. PSHE refers to Personal, Social and Humanities Education. Cutting across those key areas are generic skills: collaboration, communication, creativity, critical thinking, information technology, numeracy, problem solving, self-management and study skills. Hong Kong explicitly states that values and attitudes also cut across all subject area. Values such as responsibility, commitment, perseverance and national identity are fostered through moral and civic education.

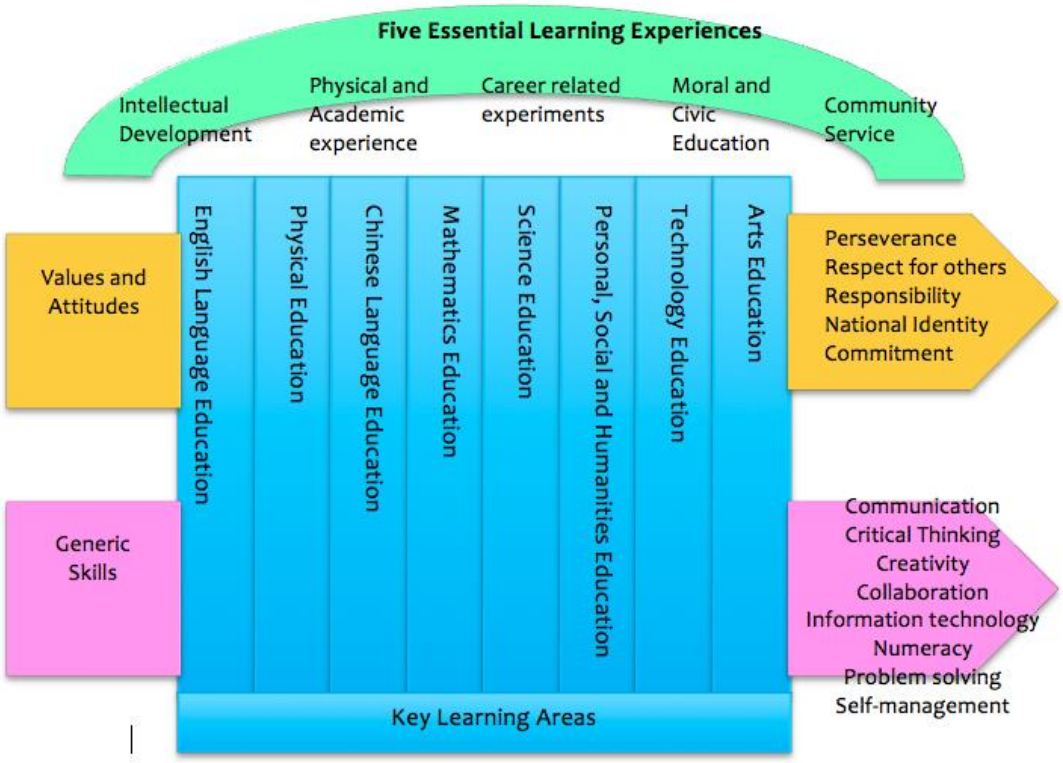

Figure 3: Adapted from *Basic Education Curriculum Guide – To sustain, deepen and focus on learning to learn* (Curriculum Development Council, Hong Kong) [English Version]

The essence of this unifying framework is still evident in the 2014 document *Basic Education Curriculum Guide – To sustain, deepen and focus on learning to learn (P1 – P6)* [CDC Hong Kong] that has been released for primary grades. Today, there are seven interdisciplinary learning goals that cut across key learning areas and act as an umbrella (see Figure 4). Embedded in the seven learning goals are generic skills: collaboration, communication, creativity, critical/discernment thinking ability, information technology, computing power, problem-solving skills, self-management skills and learning ability. Values also cut across the curriculum. Core values include sanctity of life, truth, sincere, human dignity, rationality, originality, courage, equality, kind-hearted, love, free, common good, justice, trust, interdependence, persistence, well-being, national identity. Attitudes include: optimistic, empathetic, cooperative, responsible, adaptable, respect for others, self and society, and willing to learn (Hong Kong Education Bureau, https://cd.edb.gov.hk/becg/chapter1.html#s1.2).

Figure 4: Adapted from Key Learning Goals of Hong Kong (http://www.edb.gov.hk/en/curriculum-development/7-learning-goals/about-7-learning-goals/index.html)

Three Cross-Key Learning Areas offer opportunities to learn the generic skills. The Cross-Key Learning Areas are 1) general studies for primary, 2) liberal studies for senior secondary levels and 3) applied learning. For example, about 15% of a student's time is spent in the general studies of the primary program. Here students integrate knowledge, skills, values and attitudes across the Key Learning Areas of Personal, Social and Humanities Education (PSHE), Science Education (SE) and Technology Education (TE). A goal is for students to be able to demonstrate critical and creative thinking, information management, numeracy and self-management.

Liberal studies (for senior secondary students) is a timetabled class with broad topics and no syllabus. The assessment is flexible. Students design their own learning where they rely on current affairs and information outside of a textbook. Liberal studies is considered for university entrance along with Chinese, English and mathematics. Students "develop high-order or critical thinking. This includes asking sensible questions; finding directions for analysis, synthesis and conceptualization; and proposing hypotheses or theories" (OECD, 2015, p. 103). This curriculum design sets a good example for grounding curriculum in student-directed learning. Teachers are encouraged to plan collaboratively, use technology to enhance learning and to implement hands-on learning, project-based approaches (http://www.edb.gov.hk/en/curriculum-development/kla/general-studies-for-primary/index.html).

How do teachers approach teaching within this unifying framework? There are Four Key Tasks. Moral and Civic Education is the centre-piece that interconnects with IT for Interactive Technology, Reading to Learn and Project Learning. The intent of the Project Learning is be cross-curricular although teachers can choose how they wish to implement it. Project Learning in schools is a key element of the curriculum platform.

Shanghai is the largest city in China, with a population of over 24,000,000 people in 2014, and it has a different education system than Hong Kong and the rest of China. The city was given special permission to experiment with reform before the launch of the national adoption. It is the first Chinese city to achieve 100% primary and junior high enrollment, and all students who wish to attend some form of higher education can do so. About 20 % of school children are from migrant workers (about 6 million).

Shanghai has long recognized that the exam-based culture and its attendant memorization was stifling student learning. In 1985 Shanghai moved away from multiple-choice testing to exams that tested the application of real life skills. In spite of this, exams still exist and students study long hours beyond the school day often in cram schools. The reform is still ongoing and following the reform plan for 2020.

An OECD article describes the Shanghai landscape in 2010 (OECD 2010a). In 2008, to move away from examinations and memorization, all schools implemented eight learning domains which included areas previously marginalized such as arts and physical education, in addition to language and literature, mathematics, natural science, social sciences, technology and practicum.

Schools were to create their own curriculum locally. Students were able to take elective courses. Inquiry-based education was emphasized. As well, students could do independent courses where they explored research topics of personal interest. This innovation was intended to increase social well-being, creative and critical thinking, and learning to learn.

Teacher education and professional development shifted to accommodate this new vision. Shifts in pedagogy also were implemented. Popular slogans were “return class time to students” and “for every question there should be more than one answer”. Teachers would not lecture as often and were no longer the sole authority; they were encouraged to allow class time for student activities and not just have presentations and lectures.

Singapore. The progressive policies in Singapore can lead to different models of integration (Lam et al., 2013). Singapore offers a framework that illustrates the relationship of 21st Century competencies and student outcomes (See Figure 5).

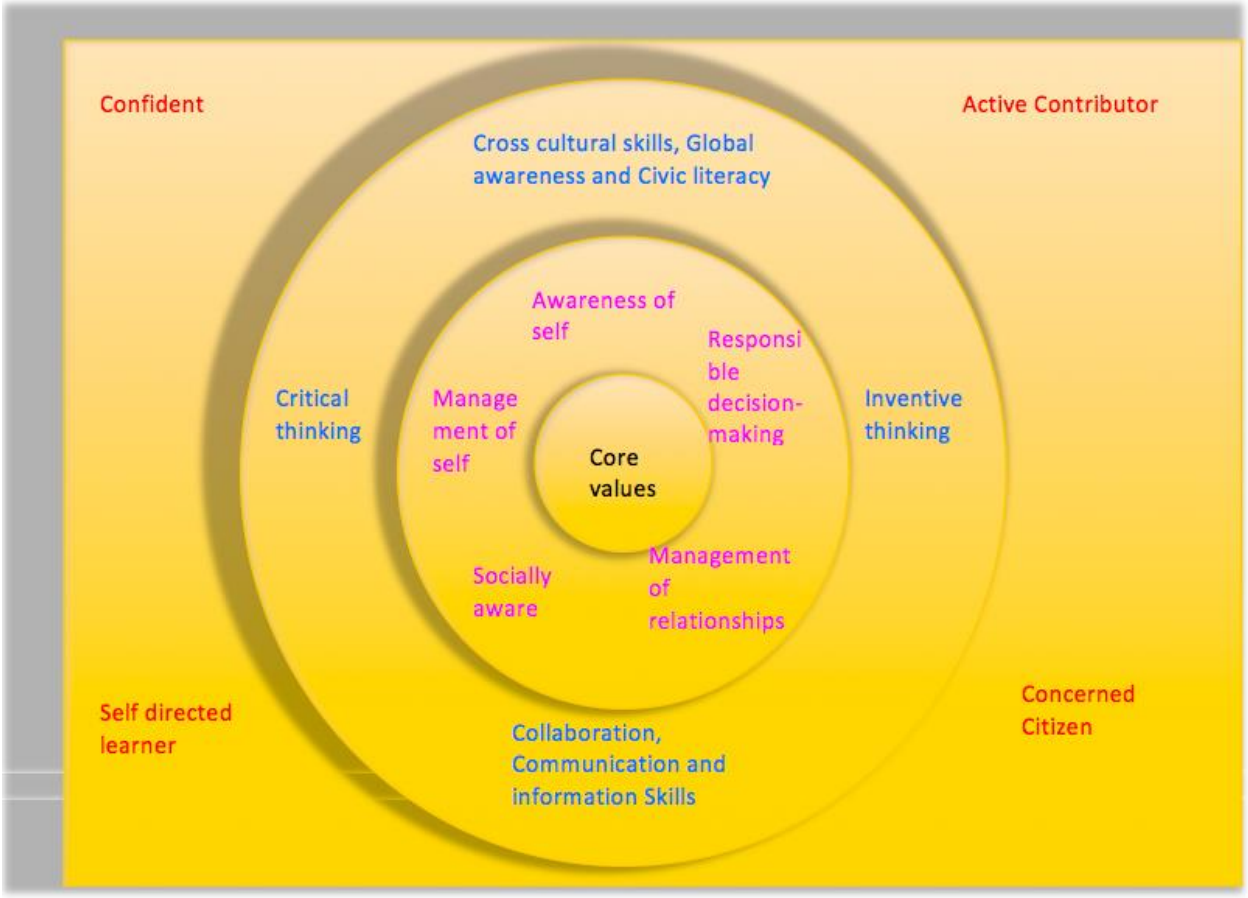

Figure 5: Adapted from the Framework for 21st Century Competencies and Student Outcomes (http://www.moe.gov.sg/education/21cc/)

The inner circle represents core values that underpin knowledge and skills and shape beliefs, attitudes and actions. The middles ring revolves around Social and Emotional Competencies. The outer ring represents the emerging 21st Century competencies: civic literacy, global awareness, and cross-cultural skills, critical and inventive thinking and communication, collaboration and information skills. Presumably all content knowledge is embedded in this framework.

The Ministry of Education offers key outcomes for students at the end of school. The student should be confident, self-directed, active contributor and concerned citizen. (See Figure 6).

The key stage outcomes of education		
At the end of Primary students will be able to	**At the end of secondary school students will be able to**	**At the end of post-secondary school students will be able to**
Distinguish right from wrong	Demonstrate moral integrity	Display moral courage and stand up for what is right
Identify their strengths and areas for growth	Believe in their abilities and adapt to change	Be resilient in the face of adversity
Cooperate, share and care for others	Work in teams and show empathy	Collaborate across cultures and be socially responsible
Display lively curiosity	Be creative and demonstrate an inquiring mind	Be enterprising and innovative
Think and express themselves confidently	Appreciate diverse views and communicate effectively	Think critically and communicate persuasively
Take pride in their work	Take responsibility for their own learning	Pursue excellence purposefully
Demonstrate healthy habits and awareness of the arts	Enjoy physical activities and appreciate the arts	Live a healthy lifestyle and have aesthetic appreciation
Know and love Singapore	Believe in Singapore and know what is important for the country	Be a proud Singaporean who is aware of Singapore's position in the world.

Figure 6: Adaptation of Key Outcomes for Education for Singapore (http://www.moe.gov.sg/education/desired-outcomes)

Singapore has also developed courses that seem to lend themselves to an integrated approach. All secondary schools need to develop an Applied Learning program and a Learning for Life program to complement their academic and student development by 2017. These courses can revolve around student interests. A description follows:

> The Applied Learning programme will serve to connect academic knowledge and skills with the real world. The emphasis is on the application of thinking skills, connecting knowledge across subject disciplines, stretching the imagination and applying these in authentic settings in society and industries. The intent is to help students appreciate the relevance and value of what they are learning in the academic curriculum and develop stronger motivation and purpose to acquire knowledge and skills. The Applied Learning

> programme may be developed in areas such as business and entrepreneurship, design, engineering and robotics, environmental science and technology, health services, heritage, journalism and broadcasting, literary arts, simulation and modeling.
> The Learning for Life programme will provide students with real-life experiential learning to develop their character and values, cultivate positive attitudes, self-expression and strengthen their people skills. This will be an integral aspect and a distinctive signature approach of Character and Citizenship Education (CCE). The intent is to instill in our students a sense of rootedness and responsibility for their community and fellow Singaporeans. Areas can include, among others, outdoor adventure learning, sports, student leadership development, uniformed groups, performing and visual arts. (http://www.moe.gov.sg/media/press/2013/09/every-secondary-school-to-develop-two-distinctive-programmes-for-a-holistic-student-centric-education.php).

Through the adoption of the Learning for Life and Applied Learning programs Singapore is committing itself to developing integrated curriculum that has authentic connections to the world outside of the schools. The Ministry of Education in Singapore hopes these initiatives will not only strengthen students' academic skills but also help develop their students' character, attitude, and self-expression skills in addition to strengthening their ties to their communities.

Korea. Korea has been interested in an integrated approach for many years. The Ministry supports increasing autonomy – curricula can be designed locally to fit the environment. Twenty-five percent of elementary, middle and secondary schools are connected to the creative management school program that promotes creativity and character education. The Ministry website features a nod to STEAM which is the integration of science, math, engineering, arts and technology (http://english.moe.go.kr/web/1707/site/contents/en/en_0275.jsp).

Kwangsoon Jeong, a professor at the Korean National University of Education in personal communication (May 27, 2015) summarizes recent changes being made to the Korean curriculum. According to her:

> We are working on revision of the national curriculum called 2015 revised curriculum. General competency and subject-specific competency will be included in the achievement standards. In elementary school, integrated subjects for the 1st and 2nd graders provided in the 2009 revised curriculum will be maintained in the 2015 version. Students study core subjects of Korean language arts, mathematics, ethics, wise living and pleasant living. There is time for independent activity and special activities. This policy lends itself to an integrated approach. Students in higher primary grades go to school longer and study core traditional subjects, but there is still time for independent and special activities. The basic instruction is supposed to instil in the students basic life habits, problem-solving abilities, a love for the country and an appreciation of culture and tradition (http://www.ncee.org/programs-affiliates/center-on-international-education-benchmarking/top-performing-countries/south-korea-overview/south-korea-instructional-systems/).
>
> In middle school, which is three years in length, a "free semester system" is being implemented. The free semester is similar to the "Transitional Year"' in Ireland. During

> one semester in the 2nd grade of junior high school, students will be study in 'general' subjects, such as Korean, English, math in the morning. In the afternoon, they will participate in club activities and career education. Given the reduction time for 'general subjects' and some recognition of advantages of this reduction, curriculum integration - especially interdisciplinary approaches – are starting to be implemented in junior high schools.
>
> In high school, there will be common core subjects, such as integrated social study, and integrated science study curriculum. Integrated social study includes history, economics, and geography and integrated science study includes physics, chemistry, earth science and biology. The slogan of the 2015 revised curriculum is "integrated curriculum of social and natural science." The main purpose is for students to develop the basic competencies of humanistic imagination and scientific creativity.

Japan. In Japan, the education reform called "Zest for Living" was passed in the Fundamental Education Law in 2006. This reform institutionalized the Period for Integrated Studies that had been introduced in 2000 and implemented into all elementary schools in 2002. The aim of this course was to foster independent work and to increase creativity and problem solving abilities. Teachers had the autonomy to develop the course with the local context and students' interests in mind. Experiential learning was encouraged in nature, social life, field study, experiments, observations, field studies and observation. Issues to be explored were not discipline-based but were concepts such as environment, health and welfare and issues relevant to students.

MacDonald (2006) investigated the impact of integrated courses in Japan from the perspective of diversity. He discovered three different approaches to diversity. One approach was to study human rights where the goal of the teacher was to increase students' self-esteem, to strengthen their ability to deal with bullying and social exclusion and to learn about the rights of minorities, the homeless and disabled. A second approach was to look at cultural co-existence. The third approach was international education. MacDonald claims that students increased self-esteem, respect for the thought and feelings of others, learned attitudes of tolerance for others and could take a global perspective of themselves as global citizens and the responsibilities that entailed.

Still Japan is not immune to the accountability culture and concerns related to international testing (MacDonald, 2006). In 2011, the government increased the hours in subject-based curriculum and reduced the number in integrated studies. Although there has been tension around the integrated studies programme, Japan has held on to its top rankings in the OECD tests.

Inquiry-based learning and project learning still exist in Japan, and overlap with integrated studies (personal correspondence, Yoshiharu Nakagawa, June 17, 2015). Inquiry is used in high school science. There are Super Science High Schools that are selected for advanced science studies. For example, Horikawa Senior Science School in Kyoto has Basic Inquiry and Integrated Inquiry. These sessions are done in association with Integrated Studies. In 2020 the government will include policy on active learning.

Interestingly all of these East Asian systems have the capacity to deliver an integrated curriculum at the national level. Singapore and Hong Kong offer a conceptual framework that clearly

illustrates that generic skills and values are to be taught across all subject areas at every grade level. This is what is most important to know, be able to do and be. Singapore, Japan, Korea and Hong Kong also have general courses that specifically target skills and attitudes/values rather than a specific subject area. They also all do well on the OECD literacy, numeracy and science tests.

One might argue that it is the "hard work and no play" ethic in the East Asian countries that accounts for their success. But the stereotype does not always fit. A 2010 OECD report describes the Japanese education culture. Education is highly valued and there are high expectations of all students. All students can succeed and success is determined by hard work and not by innate intelligence. A classroom holds between 35 to 45 students and all classrooms are heterogeneous. No student is held back and students are not differentiated by ability groupings. Instead, the Japanese teacher focuses on engaging the students. Teachers put a great deal of thought into lesson planning and often begin with a problem that students help to solve. Mistakes are valued and learned from. The Japanese classroom can be noisy and seemingly unruly at times. Although Japanese students spend a long day in school, they have frequent breaks. Indeed, from our perspective, the OECD description seems like an ideal constructivist classroom anywhere in the world.

Going beyond the obstacles of standardized testing, Finland, Quebec, Canada and the IB schools offer instructive examples for a global perspective on curriculum integration.

Finland

Finland has also done remarkably well in OECD testing, making it a focus of interest for other jurisdictions. How does Finland do it? Hancock (2011) reports for the *Smithsonian Magazine* as follows. Education is highly valued and teachers have a Masters degree and are respected and admired on an equal status with doctors and lawyers. Their attitudes are "whatever it takes" to help all students succeed. They prepare students how to learn rather than to take tests. There is no sorting into ability groups. Finland does not participate in large-scale national testing, although students do take one exit exam to determine their next step. There is little homework and students spend a lot of time learning outside of class. Teachers value play as learning. The national curriculum has broad guidelines rather than a multitude of standards. There are lots of special education teachers who will help students in need. Almost all students enter Grade 9, even the most severely disabled ones. Contrary to stereotypes, Finland is not a homogeneous population but has many immigrants from Iraq, Russia, Somalia, Estonia and Ethiopia among other nations.

In 2015, Finland announced a new policy for 2016 implementation (http://www.oph.fi/english/curricula_and_qualifications/basic_education). Initial headlines announced that Finland had abandoned subject areas but in reality it had only reduced the time spent studying them explicitly. Key pieces in Finland's reform include the following:

- emphasis on seven generic competencies that cut across subject areas
- inclusion of the seven competencies in learning objectives in subject areas

- assessment of competencies in the subject areas
- multi-disciplinary, phenomenon- and project-based studies (at least one a year)
- topics that reflect student interest
- a collaborative atmosphere, student autonomy, joy of learning, school as a learning community.
- teacher autonomy to decide how to implement this new vision (Halinen, 2015)

Halinen (2015) claims that teachers can immediately implement this new curriculum as they already have the basics of it in place.

Quebec, Canada

Quebec, Canada has its own policy of education since there is no national policy of education in Canada. Today in every province except Quebec, most curriculum documents encourage some form of integration but there is not a specific policy around this (Drake et al., 2014). The policy in Quebec, on the other hand, favours integrated curriculum explicitly. The philosophy undergirding this curriculum is constructivist. The learning is to be active, hands-on, connected to the real world, with an emphasis on collaborative learning. There is a well-thought out unifying framework that is applicable to both primary and secondary (and to both French speaking and English speaking schools). These broad areas of learning together with cross-curricular competencies are the frame of reference for educational activities K to 12.
The broad areas that cut across subject areas are Health and Well-Being, Personal and Career Planning, Environmental Awareness and Consumer Rights and Responsibilities, Media Literacy and Citizenship and Community Life.

The competencies are complex, broad-based and progressive in nature. Nine cross-curricular competencies that are organized into 4 categories:

- Intellectual: Uses information, solves problems, exercise critical judgement, uses creativity
- Methodological: Adopts effective work methods, uses information and communications technology
- Personal and Social: Achieves potential, cooperates with others.
- Communications: Communicates appropriately

(http://www1.mels.gouv.qc.ca/sections/programmeFormation/secondaire1/pdf/chapter3.pdf).

There are five subject areas: languages, math, science and technology, social sciences, arts education and personal development. Each subject area is accompanied with a chart that shows how the different subjects within the subject areas connect. As well, there is 25% of the time for teachers to develop course material that is local in nature and connects to student interests (shades of the East Asian countries). Each competency is richly defined and examples are given for what it looks like developmentally and suggestions are offered for how to assess it. In secondary school, students are required to complete a final integrating project.

From an accountability standpoint, there are provincial examinations in French, English, physical science and history twice in secondary education. Students must pass both English and French to graduate. Provincial examinations account for 50% of the students' final grade (Volante, 2007).

Over the years, participating provinces in Canada have done well in PISA testing. In the 2012, Quebec's math scores ranked just below the highest-ranking East Asian countries and above the other Canadian provinces whose scores fell (except Saskatchewan who maintained its ranking). In reading, Canadians did well including Quebec. Only in science was Quebec struggling somewhat. In a Pan Canadian assessment program of 32,000 Grade 8 students, Quebec students were number one in math, fell in the mid-pack for science and were second in language (Hammer & Alphonso, 2014).

In explaining why Quebec did so well in math, researchers say it is because of intensive teacher training in math and a curriculum that balances both drills and problem solving (Hammer & Alphonso, 2014). But little has been said about whether this province did so well because of an integrated approach to curriculum.

The International Baccalaureate (IB) Schools

The IB schools offer an interesting insight into integrated learning. More than 4000 schools around the world have chosen to embrace this model of education for students aged three to 19. These schools are located in different jurisdictions and often need to honour the standards and expectations of the country they are in while following the IB framework. Thus, curriculum design can become a complicated process that seems to be clarified by the framework itself.

The IB is a unique approach focusing on academic rigour, well-trained teachers and motivated students (http://www.ibo.org/globalassets/publications/become-an-ib-school/globalkeyfindings.pdf). These schools are interested in developing "inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect" (IBO, 2009).

IB schools may be public or private, but are guided by the same unifying framework. That framework includes integrated approaches to learning – especially at the primary level where transdisciplinary learning is policy. The IB Learner Profile cuts across all subject areas at all grades. This profile embodies the kind of person the IB student should be. Generic skills also cut across subject areas: thinking, social, communication, self-management and research skills are emphasized. As well, attitudes such as appreciation, commitment, confidence, cooperation, and

creativity are considered essential. This framework of skills and values cutting across disciplines at all grade levels is similar to the Hong Kong, Singapore and Quebec frameworks.

The IB programmes go one step further and focus on conceptual learning in content areas. Students learn transdisciplinary concepts and central ideas that go beyond the scope of the disciplines and reflect the real world. Finally, the schools are concerned with action. In the PYP, for example, "successful inquiry will lead to responsible action, initiated by the student as a result of the learning process" (IBO, 2009, p.25). This action can be service learning and can occur both in and outside of school. In this way the student demonstrates the attributes of the IB Learner Profile.

Further examples for a global perspective

Two aspects stand out in jurisdictions that were successful in OECD testing and the IB schools. One aspect is the presence of a unifying framework. Interdisciplinary outcomes/competencies that are skill and value-based cut across the content areas and are made explicit. The second aspect is that time is specifically allocated for locally-based curriculum; the content of this curriculum is left to the discretion of the teacher and is intended to connect to students' interests. In some countries this time is designated to work toward developing students' generic competencies. These common factors seem to be success factors. We wonder how essential these factors are to the successful negotiation of accountability and integrated approaches. We look at Ontario and United States for further illumination.

United States. In contrast to the systems already presented, the United States has not excelled in the international tests consistently, falling midway in the ranks most years. The United States recently adopted a Common Core State Standards (CCSS) curriculum in 43 states and 4 territories (http://www.corestandards.org/about-the-standards/). This adoption has not been without controversy and there are still many issues around interpretation and evaluation. It would be hard to describe the Common Core State Standards as a unifying framework for this large country at this time. It includes only language and math learning goals that indicate what a student should be able to know and be able to do at the end of each grade.

Some American educators, however, are seeing the promise of literacy across the curriculum and more integrated approaches (see, for example, Drake, 2012). Beginning in grade 6, the Common Core State Standards literacy standards allow teachers of English language arts, technical subjects, science, and history/social studies to use their content area for teaching reading, writing, speaking, listening, and language in their respective fields, which some teachers are experimenting with.

Although it is rarely policy, there are many examples of integrated curriculum and project-based learning dotted across the country. Much of the literature for this report on the need for curriculum integration and for teaching 21st Century skills originated in the United States. The Partnership for 21st Century Skills (www.P21.org) and other organizations like it encourage the same types of generic skills, or 21st Century skills, as the East Asian countries, Finland and the IB schools described above.

Ontario, Canada. Ontario is different from United States. It has done well in OECD testing even though its math scores have fallen in the last PISA testing. Here, there is a long history of government supported integrated approaches that have come in and out of favour (Clausen & Drake, 2010). The latest iteration was in 1993 with *The Common Curriculum: Grades 1-9* (Ontario Ministry of Education and Training, 1993a). This working document brought the concepts of outcomes-based learning and curriculum integration together and emphasized accountability, equity and excellence for students. The curriculum offered 10 essential learning outcomes across subject areas that students were to attain by the end of Grade 9. The curriculum integrated traditional subject matter into four core areas – Language, The Arts, Mathematics, Science, and Technology, and Self and Society. Documents outlined outcomes that all students were expected to achieve by Grades 3 and 6. In 1995, a more polished document *The Common Curriculum: Policies and Outcomes Grades 1- 9* (Ontario Ministry of Education and Training, 1995) was released.

In looking at this venture in the light of today's curriculum, the Common Curriculum had much to commend it and may contain hints for successful policies in 2015. The 10 Essential Learning Goals acted as a unifying framework for all subject areas. The goals included a focus on literacy, numeracy and scientific literacy as well as technological, historical and geographic literacy. Students were also to "interact effectively with others, demonstrate respect for human rights and be motivated to fulfil the responsibilities of citizens of in a democratic society" and "exercise aesthetic judgement" and "be motivated to build healthy lifestyles and relationships"(Ontario Ministry of Education and Training, 1993a, p. 11). There were general principles of teaching, learning and assessment – particularly performance assessment. At the same time there was government support for this curriculum implementation. A resource document *Towards an Integrated Curriculum* (Ontario Ministry of Education and Training,1993b) was released with the first working curriculum documents. This document offered a continuum for integration perspectives and tried to deal with issues around definition. There was a lot of provincially supported professional development. At this time the EQAO was established– this organization would administer large-scale testing at grade 3, 6, 9 and 10 to determine student success and system accountability.

This curriculum was a radical departure from the recent past in Ontario. Unfortunately just as educators were beginning to understand how to implement this program, the government of the day, the New Democratic Party (NDP), lost to the Conservatives who quickly replaced the policies with traditional ones. Outcomes were gone, replaced by expectations and large-scale testing became mandated. There was no unifying framework and learning was largely discipline-based. Ontario has worked from this premise since this time.

One document still remains from the Common Curriculum era and is currently being revised. *The Ontario Curriculum Interdisciplinary Grades 11 and 12* (Ontario Ministry of Education, 2002c) outlines how to create interdisciplinary courses by combining credits for different subject areas. What subjects to integrate is up to the creativity of the teachers involved. There are many innovative interdisciplinary courses across the province and each one is unique. Some teachers integrate four courses and students spend all day for a semester in that course. What ties the courses together is a set of interdisciplinary expectations that all students must meet. They act as a unifying framework of sorts. The expectations revolve around interdisciplinary

foundations, research and evaluation.

Reflections on the Global Perspective

Admittedly this section is brief and a snapshot in time. It is difficult, if not impossible, to know how policy is being enacted in real classrooms. The culture in these examples is also an important part that we haven't explored. However, it seems an integrated framework that addresses what is important for students to know, do and be across all subjects for all grades is linked to success; as well, a period of time that is not subject-based but is devoted to inquiry and building generic skills and cultural values may be helpful. The information here belies the myth that a student who succeeds in math, science and language studies must be in a strictly discipline-based program with drill and kill exercises. There is a clear direction/pattern in policy in these successful examples – constructivist philosophy, fewer exams, inquiry learning, project-based learning and integrating subjects to teach generic skills and values and attitudes. It seems safe to conjecture that students who excel in math, language and science in OECD testing are not affected negatively by ventures into integrated programming. In fact, one might surmise that they do better because of these programs.

Challenges with Implementing Integrated Curriculum

Discussions of implementing curricular integration address the difficulties of change. For example, the *Course Profile Science and the Community Package of Courses* (Ontario Ministry of Education, 2002b) devotes over three pages to logistics and planning issues such as sustainable staffing, staff collaboration, timetable blocking, balancing disciplines and assessment and reporting. Virtue, Wilson, and Ingram (2009) advocate incremental change to allow teachers to grow in confidence and commitment, to cede control, collaborate and see connections among subjects. They give examples of how their school developed integration from projects to units to courses.

Applebee et al. (2007) studied the experiences of 11 interdisciplinary teams and found the full range of issues discussed in the literature. Problems included insufficient preparation time, lack of resources and incompatible personalities. On the other hand, the increased enthusiasm of both teachers and students who now had a wider perspective was a positive benefit. For theses researchers, the decision to implement an integrated curriculum involved a number of trade-offs that need to be considered at the school level.

Engagement of the teacher. Some, such as Burton (2001), wonder if the benefits of integrated curriculum, could be achieved be achieved by a good teacher in any context,

> As a former elementary, middle school, and high school teacher in different subjects, I find that all but a few of the listed benefits could be accomplished by a good teacher in a self-contained classroom…The intent here is not to denigrate attempts to promote the design and implementation of interdisciplinary programs but, rather to promote what interdisciplinary implies: finding authentic interactive connections between the disciplines that will make a difference in teaching and learning. (p.21)

Ultimately, the teacher is the key ingredient to the success of any curriculum. Therefore, it is important to consider teachers' level of knowledge about, and attitude towards integrated curriculum and its implementation. Dowden (2007), in his analysis of different approaches to integrating curriculum in middle school, identified teacher opposition as the greatest obstacle to its effective implementation. Logistical difficulties such as timetabling classes and additional planning time trigger opposition, but so too does teacher identity, which includes status, personal and professional affiliations and comfort (Fenwick, Minty & Priestley, 2013). Dowden (2007) showed that resistance can be strong when teachers consider themselves subject specialists. Even when integration is accepted on principle, there can be "turf wars" and imbalances (Russell & Burton, 2000) and interpersonal tensions (Judson & Sawada, 2000) that compromise the program's success.

A lack of knowledge about the pedagogy often associated with integrated curriculum—student-centred, inquiry-based and/project-based pedagogy for example— also increases resistance. Pang & Good (2000) state that teacher resistance to integrating math and science was the result of inadequate understanding of, and interest in, inquiry, let alone integration. Similarly, the three Korean teachers who were implementing integrated curriculum for the first time in Park's (2008) case study lacked theoretical understanding sufficient to allow them to get past their traditional subject-based focus.

From fearing to embracing. Despite the challenges of adopting integrated curriculum teachers' stories of implementation have become action research and inspiring journeys of renewal (Drake, 1993; Pate, McGinnis and Homestead, 1995). Students are not the only ones who respond favorably to the learning experiences that are part of an integrated curriculum. Lake (2000) in her literature review reports on a small number of studies that explore teacher affect. Essentially these studies showed positive attitudes of teachers toward teaching integrated programs.

Barr et. al (2015) found that for the 113 teachers who participated in a case study assessing the impact of an integrated unit, there were,

> strong, statistically significant, positive effects on all eight areas of teacher self-efficacy and on two of four teacher professional engagement and burnout outcomes, including teacher-reported personal accomplishment and perceptions of professional support, engagement, and growth in the teachers' academic discipline.

Judson and Sawada (2000) found that although integration aroused resistance in one teacher, it inspired another to embrace new technology, attend workshops and develop student-centred pedagogy.

The student teachers of Parker, Heywood and Jolley's study (2012) felt initial trepidation about planning and teaching a cross-curricular unit, but all expressed positive views afterwards, citing student motivation, relevancy to student interests and use of real-life context as reasons. In a similar vein, Zwirn and Fusco's account (2009) of pre-service and experienced teachers' enthusiasm for a project integrating art and literature is another example. Initially, some of teachers were doubtful about integrated curriculum. They expected it to be muddled and lacking rigour. But as they planned and implemented a project in which they, as proxy students, wrote

plays and program notes, constructed the puppets and sets, created the "soundtracks" and performed the puppet shows, the teachers realized how excited the students would be about learning and how much learning would occur that could be assessed. After trying out the activity in her actual classroom, one teacher wrote,

> The fifth graders created narratives, dialogues and scripts and then the shadow puppets…My student teaching classroom was a collaborative class which made this experience an amazing process to behold. The final performance…was so rewarding, not only for the children but also for me as a teacher. The story came alive through art. The children were so motivated which has inspired other teachers to ask questions about shadow theatre. By teaching literacy through drama, you reach all the diverse learners in the classroom. (p. 228)

Planning and teaching interdisciplinary programs encourage big-picture thinking around outcomes rather than entertaining activities. Clark's (2011) case study of an American middle school's transition to a student-centred, inquiry-based integrated curriculum demonstrates that change can be a long, challenging but rewarding process. Kurt, the principal in Clark's (2011) study, put it this way,

> We learned quite early that the conversations that take place among a multi-disciplinary team are quite different from those that occur when teachers are talking with their counterparts in science, math, or literature. Here we are all "students," asking of each other tough questions like "Why do we need to know that?" or "Do you really need to spend all of that time on dividing fractions?" (p. 39)

The intellectual stimulation of this kind of discussion can re-energize teachers' commitment to their profession. Kurt summarized his a-ha insight: "I suddenly realized that it wasn't the curriculum we were trying to integrate. We are trying to integrate learning" (p. 36). One teacher, Donna, began the journey with this to say,

> The primary impact of these sessions is that we are questioning everything in our curriculum. There is some dissatisfaction with the thought that most of what we hold near and dear is on its way out—a hard pill to swallow—due to the changing view of the curriculum. I still have a real block on how things will look. Can we ease into these significant alternations? HELP!"(p.34)

Two years later, Donna, who had become one of the most enthusiastic supporters said, "Once you become a convert, there's no real turning back. Becoming a convert, however, is at best a very personal struggle and at worst a knockdown, drag-out fight with your colleagues" (p. 35). Despite Donna's warning, the collaborative planning and team teaching of integration is cited as a positive outcome because it breaks down teacher isolation (Howes et al., 2009). The teachers who integrated drama into the English-language program (Araki-Metcalfe, 2012) "re-discovered their strengths in their teaching and consolidated a stronger rapport with their students in a new and unfamiliar area of EFL" (p.73). And Drake (1993) found that teachers who collaborated with each other to teach in an integrated program felt the most exhausted they had ever been, but also the most energized.

Ingredients for success. In some cases educators have implemented integrated curriculum, either alone or in a team, under the most improbable conditions. In these cases, when there was a will there always seemed to be a way. Even in the most probable of contexts there are a number of strategies that should increase the success of an integrated project (Jacobs, 1991). Time is perhaps the most crucial. Teachers need to be able to plan together, either through scheduled planning periods or in some organized way. As well, a good team has people who want to be there - usually volunteers. The members of the team need interpersonal skills as there will be conflict along the way (Drake, 1993). Although a seemingly small detail, food being provided during planning meetings helps to make the group cohesive.

Professional development for teachers and for their administrators is frequently cited as key to successful implementation (Barr et. al., 2015; Hayes, 2010; Huizinga, Handelzalts, Nieveen, & Voogt, 2014). This need is also present in teacher education programs (Hardman, 2009).

In looking back at the successful Humanitas program (Aschbacher, 1991), teacher collaboration was the key to success. These teachers had to work harder than traditional teachers. Teams worked through the summer to plan collaboratively so that courses would meet state requirements. They often used primary sources instead of textbooks and revised existing material for differentiation. They also had to learn a portion of another subject in order to collaborate, for example, and to assess equitably. These teachers "almost unanimously report that participating in Humanitas is one of the most renewing experiences they have had (p. 19). The least successful teams did not really collaborate and did not meet regularly.

Teachers who participated in the Mid-California Science Improvement Program taught a science-centered curriculum through themes and the integration of other subjects such as language arts, mathematics, fine arts and social studies. Not only did student achievement in science improve, but both teacher and student attitudes improved (Greene, 1991). According to Greene, the success of the project was, in part, due to a well-planned training program and coaching model. Teachers were involved in a two-week summer institute where they worked with each other to develop a theme and effective teaching strategies. Scientists from local universities helped with the science content. During the year, the teachers were supported by their principal and fellow MCSIP teachers and through continuous staff development and ongoing coaching.

Fenwick et al. (2013) identify four key factors for success in the implementation of integrated curriculum: They are "leadership and ethos, teacher identity, departmental ethos, and space and curriculum architecture" (p. 461). The Scottish secondary school (Brae Hill) of their case study effectively delivered a social studies program that integrated Geography, History and Modern Studies. The article provides an excellent overview of the literature related to issues of implementation. In the case of this particular school, strong leadership from the department head reinforced the shared coherent pedagogical approach among the teachers. An ethos of trust and shared responsibility characterized the relationships among the teachers. Teacher identity was based on *how* one taught more than *what* one taught. These factors encouraged mutual support, minimized the discomfort of teaching outside one's discipline and eliminated competition and imbalance among subjects. Close collegial relationships were supported by the close physical

proximity of workspaces, facilitating the sharing of resources, team teaching and collaborative planning. The authors do stress the influence of a specific situational context, In summary, the Brae Hill case study demonstrates that any curriculum approach must be understood in relation to broad and various contextual factors such as school culture and physical layout. This study would be very helpful to educators interested in implementing integrated curriculum.

Reflections on Challenges with Implementing Integrated Curriculum

As outlined in detail above, "powerful forces are allied with the subject-centred single-subject curriculum, not the least being … teachers' own conceptions and views of themselves as 'subject teachers' (Dowden, 2007, p. 65). This, combined with teachers' lack of knowledge about integrated approaches, sometimes cements educational practitioners' as resistors to integrated curriculum. In our opinion, two key ingredients are required to overcome resistance, allowing for the implementation of integrated approaches in school systems. The first ingredient involves providing all stakeholders, but especially teachers and parents, theory about integrated curriculum in addition to research evidence and practical examples demonstrating its efficacy. The second ingredient involves putting in place a culture where curriculum, pedagogy, and assessment are all aligned, allowing for high-quality, relevant, integrated programs to be developed and maintained.

Conclusion

> When students engage in curriculum integration, they can begin the process of becoming lifelong learners just when they are cognitively ready to move toward the advanced thinking that accompanies adulthood — during their middle and high school years. I did not have such an opportunity until I reached adulthood and began studying the world through my own trial-and-error experiences. Why should our children and grandchildren have to wait so long to be prepared for what counts in life? Educators can fix this now. But we must begin by admitting, "It's the curriculum, stupid; there's something wrong with it!" (Brown, 2006, p. 783)

Perkins (1991) describes the "chocolate box" model of education (stuffing more and more different flavoured candies into the box of learning) as a problem. Beane (1991) uses the analogy of a jigsaw puzzle to characterize conventional schooling. Yet the analogy of modern life *outside* school is the worldwide web – interconnected, simultaneously and constantly under construction by all its users, vibrant 24/7. The contrast is glaring and gaping. Our schools need to reflect the networked interconnected model and the world we live in. It is time for a revival of scholarly interest in, and a more globalized inquiry into integrated curriculum. Then perhaps we can say: "It's the curriculum, smartie; this time we got it right!"

Method

The study utilized an empirical phenomenological research design (Creswell, 2012; Moustakas, 1994). Creswell (2012) states that the phenomenological approach is best suited for problems in which it is important to understand a collective groups' common or shared experience of a phenomenon. In this case it was important to understand the common experiences of PYP teachers with transdisciplinary teaching in order to develop or refine practices and policies and to develop a deeper understanding about the features of the phenomenon under investigation.

After securing ethics clearance from Brock University's Research Ethics Board transdisciplinary teaching was explored through the lived experiences of 24 IB PYP teachers, coordinators and administrators from a variety of schools in a variety of geographic regions, including private, public and international school contexts. Initially IB's research department, who have no evaluation power over the schools, sent the researchers contact information for 35 PYP Coordinators from schools that had been running the PYP for over 5 years. The schools were located in all 3 of IB's geographic regions (The Americas; Europe, Africa and the Middle East; Asia and Australia) and represented public, private and international school contexts. The researchers then sent Letters of Invitation and Informed Consent to each of the PYP Coordinators on the list and asked them to share the letters with their administrators and PYP teaching staff. In order to maintain the confidentiality of the participants in the study the PYP Coordinators were instructed to have any individuals in their schools interested in participating in the study contact the researchers directly through a provided email address and not to express their interest to the PYP Coordinator. The PYP Coordinators themselves were also asked to contact the researchers directly if they were interested in participating in the research project. In this way no one but the researchers knew who was participating in the study. This confidentiality was provided so participants could speak openly and honestly about their experiences without fear of reprisals from school administration or IB itself.

After this initial recruiting phase a snowball recruiting method was utilized. Every participant who agreed to participate in the study and completed a videoconference or telephone interview was asked to inform any of their friends and colleagues who currently taught in the PYP who they thought may be interested in participating in the study to directly contact the researchers for more information. Potential participants who contacted the researchers were then provided with the Letter of Invitation and Informed Consent. After reading the letter, if they still wished to participate, a videoconference or telephone interview was scheduled between the participant and the researchers. Demographic information for the participants is provided in Table 1.

Table 1: Demographic Information for Participants

Participant*	Role	Total Number of Years Teaching	Number of Years Teaching in IB Schools	Gender	IB Geographic Region	Type of School
Aimee Small	Classroom Teacher	11	6	Female	Asia and Australia	International
Agmar Velolos	Specialist Teacher	20	18	Male	Asia and Australia	International
Angel Jones	Classroom Teacher	12	8	Female	Asia and Australia	Private
Jan Samel	Administrator	19	13	Female	Europe, Africa and the Middle East	International
Carissa Black	Classroom Teacher	14	8	Female	Asia and Australia	International
Colleen Frauchette	Classroom Teacher	28	7.5	Female	Asia and Australia	International
Jack Diablo	PYP Coordinator	13	12	Male	Americas	Public
Elena Torres	IB Coordinator	21	15	Female	Americas	Public
Dana Garchinski	Specialist Teacher	28	7	Female	Americas	Public
Eva Hart	Classroom Teacher	21	9	Female	Europe, Africa and the Middle East	International
Lolita Strauss	Classroom Teacher	15	13	Female	Americas	Private
Emilia Estevez	PYP Coordinator	8	4	Female	Americas	Public
Cole Johnson	Classroom Teacher	8	2	Male	Europe, Africa and the Middle East	International
Holly Wood	Classroom Teacher	5	1	Female	Americas	Private
Jessica Barne	Specialist Teacher	25	5	Female	Europe, Africa and the Middle East	International
Sowmya Gupta	Specialist Teacher	17	11	Female	Europe, Africa and the Middle East	Private
Virginia Powell	Classroom Teacher	10	5	Female	Europe, Africa and the Middle East	International
Lilly Rose	PYP Coordinator	10	6	Female	Europe, Africa and the Middle East	International
Caitlin Stone	Administrator	17	7	Female	Americas	Private
Julia Ross	Classroom Teacher	9	5.5	Female	Asia and Australia	International
Tracy Silver	Specialist Teacher	15	10	Female	Europe, Africa and the Middle East	International
Destiny Snow	Classroom Teacher	15	7	Female	Americas	Private
Sarah King	Classroom Teacher	15	5	Female	Asia and Australia	International
Moe Green	Specialist Teacher	13	8	Male	Asia and Australia	Private

* All participant names are pseudonyms

As evidenced by Table 1 participants were evenly distributed between IB's three geographic regions with 8 participants (33.3 % of the total sample) coming from each. Consistent with IB's demographics 13 participants worked at international schools (54.2%), 7 worked at private schools (29.2%) and 4 worked at public schools (16.6%). The majority of the participants were

female (83.3%) and the mean number of years participants had been teaching was 15.4 years with the mean number of years participants had worked at IB schools being 8.0 years. In terms of their roles, 12 participants (50%) were classroom teachers, 6 participants (25%) were specialist teachers, 4 participants (16.7%) were coordinators and 2 participants (8.3%) were administrators.

Data collection consisted of in-depth interviews with participants through videoconferencing software such as Skype or over the telephone. As Moustakas (1994) recommends we used two broad, general umbrella questions that were further broken down into two more directed questions and several additional probes. The interviewer addressed the probes only if the participant did not offer any information in that area. See Appendix B for the interview protocol.

Interviews with participants were conducted by one, or both, of the primary researchers and lasted approximately one hour in length. The interview was recorded on multiple audio recorders and then transcribed by a trained transcriber. Participants were sent the transcript of their interview so they could provide clarification around what they stated. They were also encouraged to correct any errors they believed were in the transcript with regard to what they reported in the interviews. Participants then sent their checked transcripts back to the researchers.

Additionally, some participants provided the researchers with artifacts which they felt expanded on their interview. These included planning templates, links to their teacher blogs and links to specific websites or internet forums. These artifacts were considered in the data analysis.

Data Analysis

Data were analyzed using the empirical phenomenology approach (Cohen, 2001; Moustakas, 1994). In this approach the researcher attempts to suspend his or her own thoughts and beliefs to uncover the lived experiences of their participants. The goal is to comprehend the experience of the participant as it is for the participant themselves. The researchers do not attempt to interpret, or add themselves, into the data. The researcher extracts major themes that are repeated in each transcript. Then the researcher looks for common themes that emerge across the participants' experiences. These themes, using the participants own words to the greatest extent possible, are then reported.

In order to accomplish this, the researchers read over each transcript several times. Significant statements that were relevant to the phenomenon were identified. These identified statements are called the Meaning Units and could be as short as a sentence or as long as a page of the transcript. The Meaning units were then thematically organized in a situational structured description for each participant. The themes in each situational structured description were called the categories. These categories were then analyzed for common themes across participants. The reported findings below emphasize the commonality that is present in the diverse experiences of the participants interviewed in terms of their lived experiences with transdisciplinary teaching and learning.

Findings and Discussion

Three major themes emerged across the lived experiences of the 24 participants. They included: "*It's a framework, it's a framework, it's a framework!", "Get on board"* and "*Their learning journey."* Each theme is detailed below.

"It's a framework, it's a framework, it's a framework!"

All the participants identified the PYP as a framework that was designed to promote transdisciplinary teaching and learning. Within the theme emerged three main categories that related to this theme and included: A framework provides freedom, Personal understanding of the framework, and Concept confusion

A framework provides freedom. Within this category, there were 30 Meaning units contributed by 16 participants. One participant explained, "What is great about the PYP … it's there are sort of procedures but it's the framework, you have this framework that you can customize however it will fit your schools needs the best." Another participant noted, "I have loved working with it. Of course it is not perfect but nothing is right now but I think this idea that it is a framework and finding these interpretations in it is interesting I think and everybody is making sense of it which is something that I enjoy." A third stated, "What I am trying to say is PYP is a framework and then you have to find your own way into it, your own interpretations almost. Of course you have to meet the standards but how you document children's learning over time is up to you as long as you do it." A fourth participant added, "We need to understand that the IB has schools all over the world and I personally appreciate the flexibility that it has in dealing with the people that you are dealing with." Finally, a fifth participant articulated, "It gives me the freedom as an educator to do lots of [things] with kids." Other participants noted specific ways that the PYP allowed their schools to integrate in written curriculum standards from various jurisdictions and detailed the curriculum mapping exercises they had engaged in to do that. One participant commented that solidifying "how to make the [PYP] and standards all work cohesively together" is something schools need to strive for.

Not all participants, however, thought the freedom the PYP framework provided was a good thing. One participant noted, "The scope and sequence I have to say is very, very vague, very wishy-washy … [It] isn't as comprehensive as some [people] would like." Another participant expanded on this stating, "Anyone can choose the learning goals that they wish for their report card which to me does not make sense … I think it needs to be set in stone, a lot more standardized. I think we need to have, actually I would love to have the transdisciplinary skills set out in a developmental continuum where you can see … different aspects of research from grade 1 to grade 6 and see what the different levels are of that and then accordingly take the section that is your grade and be able to mark that according to the scope and sequence that was built simply for research."

Personal understanding of the framework. The second category in this theme illustrates how participants interpreted the PYP and all the concepts that are embedded in it. All 24 participants contributed to this category through 72 Meaning units. Participants articulated their understanding of transdisciplinary teaching and learning in a multitude of ways including:

"So when I think about transdisciplinary learning I think what you are trying to do is really, you know, create connections between, across and maybe beyond, the disciplines. So, you know, it becomes more than, it's almost like it transcends the disciplines, it rises above it. Yeah, so you work in this multidisciplinary way and then it's more interdisciplinary because I guess all of that together connects something that is more important than if you were just working in a disciplinary way."

"O.K., so well it's obviously a lot of time you have to find ways to make the discipline link and obviously some cannot link and have to be standalone units but, you know, just the literacy skills, clearly you're going to be able to apply them when inquiring into various units. Whether you're researching or writing or you're asking questions, literacy is the easiest discipline to integrate."

"It means when the curriculum knows no boundaries, which means seamlessly throughout the day, not chopped up lessons but, throughout the day, whether it is art, music, PE, every teacher, everybody who walked in would know what is being taught, would know what the unit of inquiry was."

"The way I have learned to frame it, and I, as an educator, have learned to frame it is to stop compartmentalizing disciplines. And when you are able to frame your thinking that way it opens the door to so much more than what you are used to teaching … and that starts with your daily schedule. If you stop putting disciplines up as isolated, standalone disciplines and core subjects, and instead of putting 'Writer's Workshop' you put 'Large Group', instead of putting 'Reading' you put "Small Group", then you are able to take the unit of inquiry and mesh it with your daily activities."

"So, for me, I really look at it from a multi-tiered approach. The first, you know, I think at the most basic level is where the subjects really are working together very seamlessly as we are exploring a real life situation, real life issue, you know, just something very relevant to the real world and as a teacher you are bringing in the subjects when they matter the most. Okay, so if we are struggling to understand, for example … [in a unit on trade] students were trying to make a choice about what to manufacture, what to charge their consumers and so we started doing some graphing of the supply and demand. If we make this many how many will you buy, if there were this many how many would you buy and started to bring in some math graphing. With that it was very powerful and a very useful mechanism for them to move where they are. So when we started looking at other ways that people trade and make economic decisions we brought in some literature that focused on trade, global trade and bringing that in. So just letting the subjects really be resources for learning … we are pulling in the subjects but never are we leaving this idea of the concept or issue that we are exploring. The focus stays on that and the subjects are just resources that we pull from."

The framework which the participants were discussing above consists of a number of components which were created to make designing, teaching and instructing in a transdisciplinary way easier for teachers to do. These components are outlined in documents such as *Making the PYP Happen* (IBO, 2007). The components consist of three areas: content,

skills and attitudes/values (essentially what the students should know, be able to do, and be by the end of the programme of study).

In terms of content IB has outlined three main concepts: central idea, key concepts and related concepts. IB often refers to the content portion of the framework as "conceptual learning". Participants articulated their understanding of these concepts in a number of ways. One participant stated, "To me a central idea is really a relationship between the concepts and the context of the unit. So you are starting to bring in that transdisciplinary theme as the context, the who we are, where we are, bringing in those things as the context and the key and related concepts bringing those in as the concepts and everything and then looking at the relationship between concepts through that context." Another participant explained, "The IB created key concepts and there are eight of them and those are sort of the primary lens that we kind of explore everything through. So every unit takes two, three, four key concepts and those are what we explore through and those are really big ideas. Like function, how does it work or change, how is it changing or causation, why is it the way it is so those are really big questions, kind of like on the Bloom's Taxonomy … The related concepts are more subject-related for the most part." A third participant stated, "Because I am a learner, I like concept learning. It's a difficult thing. In fact in working with my [students] right now on regions and they want to do what I call 'factoids' all the time. I started with a question, 'What makes your region unique?', and I kept coming back to that. They want to look at things as 'factoids' instead of as a concept. You know that all places have land forms, all places have a unique culture but they want to look at tiny bits of information that will probably not serve then well in the future and so in teaching the concepts I try really hard to talk with those and use those in my vocabulary."

The skills portion of the PYP framework IB refers to as the transdisciplinary skills or the approaches to learning. Participants also discussed their understanding of this concept in a variety of ways. One participant stated, "So transdisciplinary skills would be researching, it could be communication skills, social skills, thinking skills. I'm looking at them, they're up on my wall. Self-management skills, social skills would be like cooperative decision making." Another participant said, "If you look at the skills, you know, there is communication skills, social skills, there is research skills, thinking skills and self-management skills and then under each header there is a further sort of definition of what these skills imply. So, for example, under thinking skills you find remembering, analyzing, synthesizing, creating, you know, that sort of further refinement of what these skills imply." A third participant outlined, "They are skills that can be used throughout the subject areas or across subject areas throughout the day. And it's not that content doesn't matter but the content is used to teach the skills instead of the skills being used to teach the content." A fourth participant noted, "We also have articulation to make sure that we are covering all of those skills and we are trying to get better at teaching them explicitly rather than just saying there are communication skills involved in the unit, we try to teach those skills so that the kids know how to be positive in their communication skills in that unit."

The values and attitudes component of the PYP framework is reflected in the IB Learner Profile. This component of the framework one participant referred to as "the heart of it all and it is the heart of the whole IB continuum. So it is one of those things, like the approaches to learning, that links the PYP, MYP and DP to one another." The participant went on to articulate, "These are the attributes that we have and they're personal and they're academic and so we need to look at

them in both of those ways and they interact with everything all the time. At our school we tend to focus on a couple of them with each unit, ones that sort of speak to us and we link those quite strongly to the attitudes as well. Now how we assess those we largely do a lot of reflection on them … a big part of the student portfolio relates to the learner profile." Similarly, another participant stated, "The learner profile is that learner outcome that we are aiming for. For me, everything else is a means to that end, to becoming an inquirer. You know, to becoming that internationally minded person that is represented from those, from that collection of attributes." Another participant noted, "They are probably more often sort of integrated into the teaching. So I know a lot of people use story books to sort of model what the attributes might look like and often those books will be integrated into a unit of inquiry so we will connect to whatever the unit is and so then they can look at how the characters in the book … are, you know, internationally minded or open-minded or caring, or whatever." This participant continued, saying, "Most visible are often the learner profile attributes and they are also posted all over the school." Another participant outlined, "So I have actually made one big circle with a smaller circle and it says learner profile in the middle and then each are kind of like a puzzle piece because I want them to see and understand that each of these profiles go together to create what would be the ultimate learner, you know, and a sense of this is the type of learner we would like to become. So I will bring down one of those puzzle pieces and we will talk explicitly about it and then put it back up."

Concept confusion. Several participants noted that the PYP framework, and especially the concepts embedded in it like the central idea, key concepts, related concepts, transdisciplinary skills and the IB learner profile, was quite complex and confusing. As a result the final category that emerged in the *"It's a framework, It's a framework, It's a framework!"* theme was Concept Confusion. In this category were 36 Meaning units provided by 17 participants. These Meaning units demonstrated that the participants did not understand, or were confused about, the concepts in the PYP framework. For example, one participant, while asked to describe his/her understanding of related concepts stated, "I would say the related concepts that I am looking at, that I am really emphasizing with kids, are the ideas of tenacity, resilience, determination, perseverance, you know the big ideas about anything to achievement, trying to strive for personal excellence." Another participant, responding to the same question, replied, "We of course, you know, we always have them clearly displayed … I try to use them but to be honest in some ways they are decoration on the wall, if I am completely honest." Another participant was asked to give his/her understanding of the central idea, key concepts and related concepts and stated, "You have to begin with a conceptual understanding and those conceptual understandings you do have to develop some types of skills and you have to provide children with opportunities to develop those skills in them … Backwards by design is often used right as a planning tool and I think that's why you start with that conceptual understanding and then, ok, so what skills can children, first can they build while they're developing these understandings, so what will they need to further these understandings." Another participant, when asked to provide an example of a skill he/she would teach, stated "we taught children to be risk takers."

Most of the participant's confusion centred around the central idea, key concepts and related concepts. Many participants were not able to provide understandings of these concepts that were congruent with the IB's conception of the terms. One participant noted, "I think the related concepts in my experience working with teachers and the related concepts is the related concepts

seem to be easier to access for the students than for the teachers. The key concepts as well … especially for teachers who are new to the PYP, that kind of trips them up a little bit." From participants' responses it would appear that even teachers with several years of PYP experience still struggle with the central idea, key concepts and related concepts in the PYP framework.

"Get on Board"

The second major theme that emerged from the participant's responses was the idea that in order for the PYP to function as a transdisciplinary program people needed to "get on board" as one participant put it. The participants articulated there were multiple components that needed to be in place for true transdisciplinary teaching and learning to occur within the PYP and these components were the categories that made up this theme. They included: Educator's Philosophy and Attitude, Administration, Timetabling, Collaborative Planning, PYP Planner Issues, Lack of Experience with PYP, Professional Development and Parents.

Educator's Philosophy and Attitude. The first category consisted of 20 Meaning units from 12 participants. One participant highlighted the importance of philosophy by saying, "When I came in it had been struggling for a few years because the head of the school was not on board with the PYP and he had kind of hired a curriculum coordinator that wasn't, you know, in tune with [the program]. She had come out of somewhere in the States, she had been a superintendent there, and so a lot of the curriculum decisions was making and the people she was hiring was working against the PYP and inquiry." Another participant noted, "There are some people on my team who are not so inquiry-based and they just want to get the job done … I guess it's a difference in philosophy … it's more about having a constructivist nature, like sort of an inquiry nature, and some can't let go, they can't let go of the reigns, they don't like the messiness inquiry brings." Another participant noted, when comparing his/her experience between two different schools, that, "the desires of the teaching community here [influence how much transdisciplinary teaching and learning occurs]. Like it's a very different culture than the other one, teachers have been here maybe a longer time, it feels a bit more conservative that way, not quite as deep into PYP philosophy as my other school." Another participant noted there was "Absolutely" a conflict between people who are more transdisciplinary and people who are discipline-based. The participant went on to state he/she sees "it all over the OCC, people talk about it all the time." Adding to this another participant stated there were people who said, "I teach this subject area, that's it … we have to get new people in here who are willing to pedagogically think in an inquiry way as a teacher."

Other participants provided examples of how a change in philosophy helped foster more transdisciplinary teaching and learning. One participant stated, "Recently there have been a few really good hires, and there has been a new head of school and in some key places, especially the PYP Coordinator, she is an inspiring woman. She has had a lot of people rethink their practice and start teaching [in a more transdisciplinary way] … teachers teaching a little bit less prescriptive." Another participant said, "There is now a drive to hire teachers who aren't just good teachers but who also embrace the PYP. There are some transitions being made right now with the teaching staff and some teachers who have chosen to move on." Adding to this, a participant stated, "I am moving [to another school] next year and I think I am going in as a fixer because all of their teachers are [very traditional and standardized test focused] and they are a

PYP school so they need someone to come in and reassure them and work with them to be focusing on this inquiry-based learning and concept-based learning, which is really what the transdisciplinary framework is all about.". One participant summed it up this way, "The only thing that hinders transdisciplinary [teaching and learning] are people's attitudes."

Administration. The second category that emerged was administration. Ten teachers provided 13 Meaning units in this category. One participant noted, "Leadership is so important, you know, I think the leader has to understand how that process [of transdisciplinary teaching and learning] works … but they have to be that instructional piece too, to help support the continuation … and always analyzing what [people] are doing and [trying] to make it better every year." Another participant gave the example of an inspirational principal, "who has since passed away, who told us our mission. Our mission was transdisciplinary [teaching and learning] and how we were going to work as an IB school. We did not have the answers at the beginning but we tried things, those profiles, we did those, we lived them for 2 or 3 years, to get some planning done and she was really the person that started it all … and they have carried on that mission for the last seven years. It took a lot of hard work, high expectations for teachers, high expectations for students and parents. So it's been interesting to see how it has developed with the passing of [the principal] … we felt like we could not let her down, and that we continue in this way and in a way it is kind of an emotional bond but it is also an academic bond. Academic meaning this is what we need to do, our kids have been successful and we are going to continue to carry on." A third participant stated, "Our administrative team is really strong and the main goal is for us to be a true PYP school. So in almost any way they can they support [transdisciplinary teaching and learning]. It has not always been that way at this school but I would say for the last 5 years that has really been the case. Everything is devoted to it, there's money, there's time, there's support."

Other participants noted that their administration in some ways hindered transdisciplinary teaching and learning." One participant noted, while interviewing for a PYP teaching position at a new school, "I [was] not really sure this [was] a PYP school. There were question marks even early on in my interview with [the principal] when she said she knew moving to a PYP school was a top priority for me in looking for a new job but she said I needed to understand that there were programs that needed to run and immediately, to me, it was like oh no, because it was a very program-driven school … [the] current PYP Coordinator has been there for several years and she has no experience in a PYP classroom and so she has come from the US and has a very standards-driven understanding of instruction." Another participant stated, "Labelling this as a PYP school is a farce. Administration has created an environment, through the timetable and the lack of time for collaborative planning mostly, which focuses more and more on single-subject instruction and specialist teachers. We are required to do blocks of Reader's and Writer's Workshop and standalone math and must write this into our classroom timetable so parents know at all times what we are doing."

Timetabling. The third category in the *"Getting on Board"* theme consisted of 21 Meaning units from 14 participants. Participants noted that how the timetable was constructed was often directly related to the underlying philosophy of the school and especially that of school administration. On occasion, however, participants stated that the timetable was the result of historical events or current events, such as construction. Participants commented, as this one did,

"that if you are truly going to be transdisciplinary you can't tell teachers to spend X amount of minutes on each subject. That totally contradicts the bigger idea." Similarly, another participant stated, "I personally believe that we are at school to learn. We shouldn't have to be needing to do math from 9 to 10 o'clock." Another participant said, "Some schools …. [are] very program driven so I was told to have a block of reading instruction for 50 minutes and a block of writing instruction for 50 minutes, etc., and it was a very segmented day. I believe … the more integrated the curriculum is the more authentic the learning experiences can be for the children and the more meaningful for them. That it makes more sense for them [to not have a strictly set timetable] because their lives are not segmented in that way. The things, the skills that they need transcend one moment in time and I just think it's the right way to do it." One participant who articulated that transdisciplinary teaching and learning was fully implemented, and implemented well, at his/her school stated, "We are given the time and also the freedom to design units as we like, with of course the oversight of the PYP coordinator. But unlike I know many of the public schools in the States we are not bound rigidly by timetables or time frames or state testing that we have to do. So just the freedom to merge subjects and deal with them in the PYP way, within the framework [promotes transdisciplinarity]".

Other participants referred to the conflict between the amount of time being given to teaching subject-specific classes by specialist teachers and transdisciplinary teaching and learning being enacted in terms of school timetabling. One participant explained this by saying, "I think over the years more and more of the day is being, there is a bit of a conflict, so more and more of our daily timetable is being handed over to the single-subject [specialist] teachers … which is leaving homeroom teachers saying we do not have enough time in our daily schedule to teach all of the math, all of the language, all of our units of inquiry. We just don't have enough time." Another participant noted, "I would say something that really hinders [transdisciplinary teaching and learning] is the schedule because we have these specialist subjects … it would be nice to have it be a bit more flowing so we have always asked for them to have times without specialists on the schedule, like hour-long chunks, at least an hour-long chunk, because good inquiry I believe really needs at least an hour." Another participant pointed out that, "the specialists have become, you know, they have all got their periods, and because they are seeing the kids fairly regularly they are now going ahead with their own scope and sequence that they are now developing. They have their curriculum but they are now just getting through their material because we're all basically running on different clocks and we are all running on different times and everyone has to get through what they feel they need to get through so I feel that [transdisciplinary teaching and learning] has definitely fallen by the wayside over the last couple of years." Other participants noted the timetable could also hinder transdisciplinary teaching and learning because the timetable does not provide time for the classroom teachers and specialist teachers to collaboratively plan. One participant outlined this issue by stating, "The classroom teachers have timetabled planning time it's just the extra people like the librarian and other single-subject teachers who can't always get to all of those meetings." The result of this is that transdisciplinary teaching and learning is decreased.

Collaborative Planning. Despite being mentioned in terms of the timetable above, 24 teachers generated 58 Meaning units on Collaborative Planning making it the fourth category in the *"Get on Board"* theme. The majority of participants stated that collaborative planning was essential to transdisciplinary teaching and learning. As one participant said, "You can't do it without it … so

you cannot, absolutely, cannot do any transdisciplinary curriculum without the team meetings." Another participant stated, with respect to collaborative planning, "It's key, it really is. My own development and understanding of the power of collaboration really came in when I started collaborating with other people. Different people have different ideas and different skills, right, so I think collaboration is a powerful process but in terms of transdisciplinary learning on top of that, when you start collaborating with different people from different disciplines and the kind of expertise they have and the depth of understanding … it builds their understanding of these big ideas but also to see where the links are." Another participant made the point, "At the schools that are very well into their IB you see it everywhere. For example, at my current school the specialists and the [classroom] teachers work really well together to ensure that transdisciplinary teaching is occurring."

Other participants, however, identified issues with the collaborative planning process as it currently existed. One issue the participants identified was scheduling meetings where everyone could attend was difficult. As one participant stated, "It is something that is extremely hard to do, it is extremely hard to coordinate schedules … to be honest the biggest complaint that the staff have right now is that we are not coordinating with the specialists, we are not seeing them enough to actually be able to do any meaningful transdisciplinary learning or at least setting up some activities that allow for transdisciplinary learning as out times are too short." Another participant noted, "So the issue comes for us, we don't [collaboratively plan] as a whole school because we have specialist teaching … when my students go to Spanish that is sort of no contact time for me [and I have no collaborative planning time with the specialist teachers], so it's not actually transdisciplinary if that makes sense. We have sort of been swimming upstream in that way for a long time."

Another issue participants identified with respect to collaborative planning was the collaboration was not equitable. One participant explained, "What happens in the PYP is they create these units of inquiry as classroom teachers, so these units are already created, and then now [the specialist teachers are] supposed to fit into this. So suddenly we are having to fit into something that has already been created, we haven't had equal ownership in the process." Similarly, another participant commented, "I think from what I understand it's from a classroom teacher perspective it's being done, they are looking at the transdisciplinary skills but in the single subjects it's still not really being addressed." Another teacher argued, "there are so many teachers who don't actually understand what it means to collaborate." A fourth participant noted, "Because I am not [a classroom teacher] I am not at all of the planning meetings and … I am not there for the main parts of it." A fifth participant stated, "Okay so there is conflict between the specialists and the classroom teachers and this notion of transdisciplinarity as some of the specialists feel that their subjects, and themselves personally, are getting short shrifted in the name of transdisciplinary teaching." One participant summed it up, "There are a lot of things that are done for collaboration's sake but it doesn't really reflect a collaborative nature at all."

PYP Planner Issues. Another category, which is related to collaborative planning, is PYP Planner Issues. There were 28 Meaning units in this category generated by 20 participants. In general, most participants stated they liked the backwards design process the planner promoted. One participant stated, "I like the process of it. The process makes sense to me. You have a central idea that fits under the theme, then you come up with the concepts and the lines of

inquiry and the teacher questions … and then in Box 1 is the summative assessment and it gives you what you need to head towards, what is the ultimate, what's the evidence that they've reached the understanding of that central idea by the end of the unit. Then from there is Box 3 where it shows all the formative assessments." Similarly, another participant stated, "The PYP planners do a really good job of listing everything in that specific order, so we look at what the summative assessment will be for a particular unit and then go backwards." A third participant noted, "I feel it is necessary. I do feel that it is very time-consuming, especially when you are creating a new unit. I feel it makes sense in terms of the backwards design, it makes sense in terms of, you know, showing the different activities. I think some schools take it to the nth degree and really go overboard while some schools do the exact opposite and there is no use in it at all."

Some participants, however, felt there were some issues with the design of the planner itself. One participant stated, "It's a little too structured and the organization of it, like the skills and the learner profile and things like that, are a bit of an afterthought in the way the planner is organized." Another participant noted, "In the planner they kind of have it a little bit backwards because they don't even have you decide what your learner profile and your skills are until the bottom of that box 4 and because we are not supposed to do anything I have actually switched the orders inside the boxes." A third participant stated, "It is backwards by design, which is great and it really gets you focusing on the things like the key concepts, but it doesn't provide enough focus on those approaches to learning and the related concepts." A fourth participant stated, "I think the process that it encourages is really good and it makes sense, it's logical and I have seen it work. It's just the logistical bits of it, like there is box 4 where you list all of your learning engagements and it is this really tiny box, like it's just not really readable or useable." A fifth participant stated, "I feel like I need more space because there is not enough space there."

Participants also noted that the planner was more of an archival document than a living document. Most stated they did not actively use the planner while they were teaching. They used it as a guide for their planning and then they returned to it after the unit was complete to reflect on it. Many participants talked about creating their own planners that they used more frequently while they were teaching and some participants shared these with the researchers. One participant explained, "I don't know how much they are using [the planner]. I mean they do sit down with it and they document all of their thinking around it but there is a lot of Google Docs at our school … and I think that kind of distracts them from all of the things that get placed on the planner… the expectation is that we use the planner but I think it is more a part of the culture of the team now [to use their own Google Doc planners]." Another participant noted, "I have so many things going on in my classroom, like I change things every 10 minutes because of the age of these kids and I don't have quite enough space on [the planner] so that's why I colour code my own [planner], where I plan each day." A third participant stated, "I know in our school our PYP Coordinator has devised a series of other documents that we also use but we are not allowed to scrap the PYP planner completely." A fourth participant said, "Right now it is mainly a planning tool that we mainly return to, to do our reflection afterwards and then archive it and then move on to another unit." A fifth participant commented, "Like I said, we have such limited time for planning that [the planner] is like an artifact. Sorry but it should be authentic and updated more regularly I believe, more reflective of the practices as they are occurring as opposed to, okay we have completed this unit of inquiry, okay now let's reflect on it and make

notes on what went well." A sixth participant argued, "They shy away from, or they're averse to, these planners because they think it's just documentation, [it's a way administration] make sure that we're following the standards and practices of the IB."

Lack of Experience with the PYP. Eight participants created 10 Meaning units that created the fifth category in the *"Getting on Board"* theme: Lack of Experience with the PYP. These participants discussed hiring more teachers who had experience with the PYP or at least a working knowledge of the basics of the program. One participant stated, "[we should] recruit more teachers that maybe have a bit more experience in the PYP." A second participant said, "Employ people who have got at least those foundational courses like Making the PYP Happen."

Participants discussed how there were often issues with teachers who were hired who did not have any experience with the PYP that hindered transdisciplinary teaching and learning. One participant stated, "I've seen this at all the IB schools I've worked at. When teachers are brought in, either new teachers, and even experienced teachers, into the PYP who have no experience with it, they quickly get overwhelmed and often then become negative forces in the school. They often … then start doing their own thing which is to teach standalone units." Another participant noted, "The [negative] attitude comes from lack of understanding, lack of experience, unwillingness to change, fear of change. It's not always easy to share what you are doing with someone, a lot of teachers close the door and do their own thing." A third participant stated, "The PYP is complex. There are a lot of parts to it so for a new teacher to come in that was trained in a different way, they really struggle. There is a lot of stress and frustration. One way to fix that would be to only hire teachers with PYP experience or set up a good training program for new teachers interested in teaching in the PYP that they had to take before they would be hired."

Professional Development. P.D. was another category that participants discussed as a way of *"Getting on Board".* Twelve participants generated 12 Meaning units in this category. The participants discussed that professional development could be an important way to foster transdisciplinary teaching and learning in the PYP but they had several concerns over how, and what, was being presented as professional development. One participant stated, "I think professional development is huge but there aren't a lot of great models for how to teach in a transdisciplinary way." Another participant commented, "Their workshops are becoming a little bit dogmatic … they are just so broad because they have so many different kinds of schools that are now starting to use their program and they have to cater to so many people and their workshops are reflecting that. So the depth is gone because the kinds of people going to workshops are fairly different. And then when it comes to the in-school workshops they didn't really cater to our specific needs whatsoever. We did a workshop on inquiry and we feel that our school is no further along as a result of that workshop, which is really disappointing." When asked about professional development learning on transdisciplinary teaching and learning, a third participant answered, "Transdisciplinary teaching and learning, I am not so sure I would actually say there is much."

Other participants discussed how there were issues with how professional development was being disseminated. One participant described the problem this way, "They have a curriculum to be taught but the person who is delivering it always has their own spin on exactly what it is. And all of those ears in that room they hear what they think the person is saying and they say what

they think they heard. The information is then passed down between so many ears and mouths that we are not getting the same message at all … [Additionally] they send some people to different courses every year but there is no consistent way at our school for sharing knowledge acquired at these workshops … so it is possible that a grade two teacher goes and because I do not teach grade two I never hear anything at all about what this person learned." Another participant talked about how there were issues with bringing experts in to the schools as well saying, "We thought we were doing a good job [with transdisciplinary teaching and learning] and [The expert] met with the whole team, PE, Music, Art, Library and we said hey this is what we are doing and she said, whoa, whoa, whoa, hang on a minute, you are not really doing the right thing here and then we didn't have an opportunity to have a second meeting with her so we never found out how to make it right."

Several participants also discussed some ideas of how to make professional development more effective. One participant suggested, "More modelling of what it looks like when you have all the pieces in place, you know, you've got the concepts, related concepts, your talk about the learner profile and your attitudes, and what does it look like when somebody is making all that happen in a meaningful way. You know what does it look like when kids are doing it … it doesn't have to be in-person modelling but you could have videos, you can have people giving tours of classrooms by Skype, of other places like that to see what it looks like when its working really well." Another participant suggested, "And there would be Job-Alikes across the city … where different schools … would offer to do a session … where you just kind of share what you are doing in your field. So it might have to do with a particular transdisciplinary theme, people might just get together to kind of share their ideas about that."

Parents. The final category in this theme involved parents *"Getting on Board".* Nine participants created 11 Meaning units that related to Parents. Participants discussed how parents influenced what was occurring in the schools. How parents influenced what was occurring seemed to vary by context. For example, one participant stated, "parents buy into the transdisciplinary nature of the PYP Program and so we don't hear people saying things like why aren't you teaching more direct math or why aren't you teaching more history." Another participant noted, "I think part of the reason [parents like transdisciplinary teaching and learning] is that this type of teaching allows the students to be very much involved and engaged. So sometimes, you know, you see a kid that might have struggles with grammar and French and things like that but when we are doing those modules [in a transdisciplinary way] they are able to shine so I think parents appreciate that."

Other participants discussed how they have had to struggle to explain the PYP to parents and get them to approve of transdisciplinary teaching and learning. One participant stated, "There is definitely a big learning curve with parents so we have had to constantly be helping them understand the program better." Another participant noted, "We had some confusion from parents but we invite them into the school to see what their kids are doing and we meet with them and answer their questions. It's been a struggle at times but most parents are supportive now."

Other participants discussed how parental pressure has more negative effects on transdisciplinary teaching and learning. One participant noted, "It is highly competitive … there are only so many

schools … and so [parents] look at how many math periods their student will get at this school versus how many language periods … and they need to see that Gym is happening this many times a week, art is happening this many times in a week in order to compare apples to apples from the other schools." So the school has needed to arrange its timetable to demonstrate this disciplinary focus. Another teacher commented, "The parents focus much more on the subjects and the amount of time spent on each subject and how well their child is doing in each subject." Participants outlined how this pressure from parents led to changes in their classrooms. One participant noted, "[School Administration] said from a parent's point of view there needed to be a timetable on the wall saying that at 10:00 it was math." Another participant stated, "We get lots of questions from parents and sometimes a little bit of pressure about what we're doing and how we are doing it." Similarly, another participant said, "One of the children went home and said we didn't do math today and the mom rang me and then she emailed me and said such and such said you weren't doing math, you didn't do math today. We did but [I had to explain] this is what we were doing and they don't actually realize what it is."

"Their Learning Journey"

Despite some of the issues the participants discussed which made implementing transciplinary teaching and learning in the PYP a challenge, they all stated the PYP benefited students and aided them in their learning journey. In this theme three categories emerged from the participant's responses: Rich Performance Assessment Tasks (RPATs), Student-directed Learning, and IB Program Alignment.

Rich Performance Assessment Tasks (RPATs). The first category that emerged in this theme was RPATs, which 16 teachers generated 24 Meaning units about. The participants described significant learning tasks their students had accomplished in *"Their Learning Journey"*. Many of the participants described these tasks as their best experiences in the PYP, and provided them as exemplars of transdisciplinary teaching and learning. Participants described them in the following ways:

"At our school we have a program … where you have a teacher who is dedicated to providing an [authentic] experience for all the classrooms. So each classroom gets to go out for a week with this particular teacher and they do a series, I want to call them field trips but they are richer than that, and they go out and they work in this setting for a week … I was teaching grade 2 and I went and the unit that we were selected to go out with was our unit on natural resources and so we went and spent five days in the rainforest. And I think for me, I have been on lots of field trips in my life, but for me, that unique way of teaching [in an authentic, transdisciplinary way] let me see things really coming alive in a different way … and not because we finally brought the learning outside into the world, because we had done that before, but I think it was just being immersed in a conceptual program, that was richer because it was less about acquiring knowledge and more about deepening students' understanding about these concepts."

"The kindergarteners were studying about celebrations and when they did celebrations under the theme 'How we express ourselves' they were learning that people celebrate for different reasons and that individual celebrations are different around the world and that there is always a purpose. And so as they went to each of the specialists throughout their unit and they planned as a whole

kindergarten by voting on which part they would like to create for their own celebrations. So week-by-week they sort of built on it, they picked what colours they would need for a celebration and the purpose of their celebration and what would be included in their celebration. They planned out the whole thing with the guidance of the teachers and then they had their celebration night. It included games they had created, they decided their theme would be fairy tales and they decided on their colours. All created by the kids and guided by the teachers."

"Last year, when I taught in the kindergarten classroom, doing a five senses unit we were able to use the community and go out into the community, visiting pet stores, visiting the library and the fire station, inviting community members in and seeing the excitement on the children's faces when they were able to have community members come in and share their knowledge. And that's, to me that's real IB when you utilize all of your resources that are at hand, it doesn't have to cost any money, but having an eye doctor come in with all of his tools and utensils , having families or parents come in. But my best teaching probably related to that unit was working with my co-teacher and digging really deeply into the five senses, authentic experiences like drawing blindfolded and smelling different smells and practising sign language. It was a great unit."

"So we were doing a unit on water conservation and the environment and it was a grade four class and they lacked interest, they lacked desire, they just wouldn't engage in it at all. So with the permission of [the administrator] I set about turning one of the courtyards into an experimental area and we called it 'The last bucket of water [in the country]'. The students basically had to decide how they were going to preserve it. They had to unlock the thought processes they needed to be able to create and question other students, faculty and parents [for solutions]. We also had the first ever debate in grade four because it is not a culture that actually encourages debate. The students were able to access research data that they perhaps would not have ever known was available to them and as a result of that we actually won a government award … There were several hiccups that I created along the way where the weather started to warm up and I may have helped evaporation along a little bit and they had to figure out what would happen now … there was an overnight pollution episode that occurred and they had to figure out how to clean the water without losing the water. It was transdisciplinary … we were measuring water, we were using fractions and things like that. We used literacy because we were reading about things that we could do to protect our water, we were writing letters to government departments asking for guidance and information. We were conducting science experiments on dirty water to see how we could clean it. You know we did some social studies and some geography because we were figuring out countries that didn't have problems with water from a volume point of view so it was about the [problem] in every aspect of their learning."

"The children were exploring public spaces and how they serve the diverse needs of the community. So at the end of the unit the children were asked to create a public space with recyclable materials and then kind of explain what type of public space they have created and how people would use it. This is a great one. That seems to be quite an authentic task to assess children's understanding of that big idea."

"We have a lot of trouble with stray animals in [our country] so they were interested in this idea so they started to explore everything and it was very difficult for them to narrow down what they wanted to explore. So first we got them down to a couple of different concepts, where they

decided they wanted to look at how rescuing stray animals [in their country] works and what the history of that is, which we can call change, and how people have been helping stray animals and what our responsibility is as people. And so they started and came to the conclusion through education that people [in their country] don't really have pets, they have like dogs for guarding but they don't have pets so it's very easy for them to just put a dog out on the street because they don't see them the same way Western people do. We have a lot of Western kids at our school, or more westernized I suppose, so they find this quite upsetting. So they decided through action and education they could improve the lives of stray animals in [their country] … That gave them the focus to carry on and move forward with their work [their solution to the problem]".

"We also have a school store that third graders have to apply to run and we link it to IB, they have to tell what IB attitude would help them with this job or why they should be the one, or how they can show leadership by working at the school store. It's like an application, like a real job application. We have been able to have 30 of our 100 students do that this year."

Student-directed Learning. The next category in this theme is Student-directed Learning. Thirty-three Meaning units were created by 17 participants in this category. Many participants talked about student-directed learning being the epitome of transdisciplinary teaching and learning and a goal they were striving to do more of in the classroom. One participant stated, "There were some units that I really did feel were more transdisciplinary than many of the other units because we were really able to create that learning atmosphere … we would put students in charge during the time and so they had some leadership roles within it but then as teachers watched the inquiry really unfold, responded to questions and planned little mini-lessons and such to help them move forward in their thinking and then turned it back over to them and continued to watch and assess how things were going. So I really loved the amount of student direction within that unit and really for once I felt like that guide on the side, the presence of really moving them through their learning journey". Another participant replied, when asked what would improve the PYP at his/her school, "getting more of a student-centred approach to learning going here and really seeing that materialize." Responding to the same question another participant stated, "I think the attitude of the school will be to embrace children for being children and young learners and minds, not minds to be opened up and shoved information in, but people who can develop understanding on their own with opportunities to grow and be creative."

Several participants discussed trying to bring in student-directed learning through genius hour, or passion projects, where students are allowed to direct their own learning. Genius Hour is a teacher-created phenomenon based on a practice at Google where employees get a certain % of paid work time to work on inquiries of their own interest. In schools, students are given a set amount of time – for example, every Friday afternoon - to generate their own questions and conduct their own inquiries based on their personal interests and not the set curriculum. One participant stated, "What is happening a lot more is that … we have something, some people call it 20% time, genius hour, passion project, we have a lot of that starting to happen in the school as well because we do find we are struggling to find the time for really deep inquiry in our units because of all these time restrictions and that we want students to have real time like this … student-led inquiry is exciting for kids and that is where you are teaching those skills and the knowledge is coming more from the kids. So a lot in the upper [primary] grades they devote some time to genius hour every week." Another participant explained, "Focusing on the genius

hour really gets them wanting [to learn], it's that time where you learn as you need to learn. It's like with technology and you want to try and figure something out on your computer. When you really need it, that's when you're going to remember it. It is the same with the approaches to learning and really talking, having deep conversations about related concepts or the learner profile, they happen when the kids need to talk about them or need to know them and that happens during student-led inquiry." Another participant stated, "We also know how important it is for kids to guide their own learning and take steps to build their own questions and learn more and take next steps. So last year a quick story would be the specialists got together and talked about how we could let the kids plan their own unit and that turned into planning their own activity night. So now we do activity nights that complement our units."

Other participants agreed, stating, "one of the biggest things that IB is trying to do is to let kids take ownership over their learning and being able to plan their learning and extend it on their own." As evidence for this statement they made reference to the final exhibition. One participant explained it by saying, "When students do an exhibition, when they start the process of exhibition, and it's the closure to the PYP, it's almost like they are kind of going through a unit planning process itself. They don't literally do that but a lot of times they sort of do that in small groups. A group of students will take a topic, maybe a branch of what we are studying and they develop their own lines of inquiry, they develop their own action piece, they develop what their central idea is going to be, what they are going to study. So they really are, they really develop their own unit. It's like a project that they develop and it really is a demonstration of their learning."

Similarly, another participant stated, "It's the closure to the PYP program and when we had our exhibition it was exciting to see the students, how they took on the learning themselves and they put together their whole projects, their experiences, and they really went through a whole unit planning process in their little groups and when they were sharing their knowledge and sharing how they connected with the community to do research about topics, kind of a branch off of what we were studying and it just led to other levels of learning. I think it was really exciting to see that we had the exhibition in a couple of different museums and the students and the community came out to watch them and to just watch the students talk about their learning. I think that was really exciting."

A third participant outlined, "I am fairly involved with the final exhibition … I do a lot of work with the whole class, so with 80 kids, and for this they have to explore the different key concepts that the IB uses and it's hard for them to choose this because they do not have to do this at any other time in their lives [up to this point]. So we really explore what those concepts are and they break them down and they have to make their own central idea, which is kind of the big idea that they want people to take away from their project. And that is a real challenge for them to do and I have to say that is probably the most exciting thing for me is having them choose. Student-led inquiry is the biggest piece of [transdisciplinary teaching and learning], where they really understand what they are trying to explore." A fourth participant questioned, "I don't understand why IB does not just make the PYP a series of exhibitions in each grade. Everyone, teachers, parents, the kids themselves, all value it the most, so why not base the entire program on student-directed learning?"

IB Program Alignment. The final category in the "*Their Learning Journey"* theme that emerged was IB Program Alignment. Ten participants generated 12 Meaning units in this category. Participants, particularly at schools that operated more than one IB program, talked about the alignment between the PYP, MYP and DP programs. They discussed several aspects of this alignment. One aspect that several participants touched on was curricular alignment. One participant stated, "So getting our standards and benchmarks sorted and making sure they are aligned with the middle school and high school programs is a priority." Other participants discussed having curriculum coordinators that ensured the curriculum spiralled and aligned for all subjects from kindergarten to grade 12. Still other participants discussed creating subject-specific scope and sequence documents that aligned across all three programs but only in the one subject.

Other participants discussed how the IB programs were not really aligned at all in terms of the program philosophies. One participant explained, "PYP is transdisciplinary, MYP is interdisciplinary, DP is more disciplinary." Another participant stated," Our actual subject-to-subject programs are not really aligned. I suppose they are aligned in so much that PYP, MYP and DP have aligned their big picture documents but we are not more closely aligned than that." Where participants noticed the strongest alignment between the three programs was in terms of the IB Learner Profile. One participant stated, "[The IB Learner Profile traits] is the one thing that is completely, and has always been, aligned between all three programs. They learn about them from the day they walk in, any language we use always goes back to them, any type of character building there is, you know arguments or whatever, comes out then."

Despite the perceived lack of alignment, participants discussed how they believed IB was actively making changes to the programs so they would align better. One participant stated, "That is something that I think IB is working on. I know that they have just released the new MYP documents and I think a lot of what the PYP was doing is now within the MYP. I think it is always a shock to the student system from the MYP to the DP because it is much more disciplinary, you have to get through certain curriculum in order to write these exams. So again, while there is more looking at things through inquiry there is also we have to get through this material." Another participant commented, "We are having similar challenges [to those in the PYP] in the MYP in these things because when they move into our school in the MYP they have a teacher for math, a teacher for humanities, a teacher for language arts, a teacher for design and technology and they don't have collaborative planning with each other so the humanities and language teachers [for example] who you think should be able to make some really strong connections, don't because they don't have any co-planning time and it makes it almost impossible for those things to happen." Still other participants discussed how the planners in the PYP and MYP had been made more similar, which they interpreted to mean that IB may be moving toward aligning the programs more closely.

Student voices

In this study, we have explored teacher experiences. This last section is a brief snapshot of 3 students' experience in one IB school. They were interviewed after a student-parent conference. Although it is not generalizable in any way we think it does offer a flavour of what it is like to be an IB student.

John is an athletic boy who excels in most things that he does including school. He has just completed his Grade 5 exhibition. His poster on air pollution still sits centre stage in his home. He states that air pollution is just one kind of pollution and recognizes that pollution is a concept. He says that he is not a good person to ask about his education even though he realizes that reflection is a part of what he does every day in class. Perhaps he is shy, because he is quite articulate. When pressed about his IB experience he says that he has really enjoyed working with other students on his exhibition. In fact he says several times that he can't really describe why he likes school so much – "it's just that it is fun."

Elizabeth takes her responsibilities as a Grade 3 student to heart. She proudly displays her work at the parent-student conference. She can talk about most topics in depth and is most knowledgeable about animals. It is quite amazing what she has learned in her short 9 years. What is most impressive about Odessa is her ability to reflect. Throughout the conference she shares with her reflections on her class projects with her parents. She clearly understands concepts in some depth and also procedural skills. This is the first year that Odessa has made close friends in her class and she is really enjoying school.

Ethan is in his first year kindergarten. He is a left-handed boy who struggles a bit with the arts and writing (his teacher says he is doing well for a left-handed boy). At first in his parent-student conference he is shy and not forthcoming. But eventually he shows his teacher and parents what he knows about measurement. He can measure things in a variety of ways and clearly understands the basic concept. He then shows how he knows the calendar and can read the names of the others in the class. He proceeds to demonstrate knowledge in a variety of areas. He leaves his conference (a full hour where he is the only student) on a high. He has done very well in his presentation of his skills and knowledge and he feels confident having communicated his knowledge well.

Recommendations

All of our participants appreciated the potential of the IB philosophy and the PYP program. The interviewees were self-selected and participated because they had something to say. Usually these comments were very positive. Negative issues that emerged were around poor implementation for a variety of reasons and lack of leadership that was specifically IB-knowledgeable.

We ourselves were very impressed with the both the philosophy and thoughtful infrastructure that grounds the foundation of the IB program. We offer some recommendations here based on the review of the literature, the results from the interviews and a critique of IB documents such as *What is an IB education?* and *Making the PYP happen*.

Transdisciplinary as a Direction

We like the term "trandisciplinary" as a way to describe the PYP program as it gives it a distinctive identity and adds a 21st Century lens. The term rarely describes any K to 12 programs in the literature, but in the university realm, transdiscplinary is increasingly being used

to describe innovative programs that disrupt the boundaries of the traditional disciplines and lead to generating new knowledge in the complex global world we live in. From a marketing perspective, we expect that transdisciplinary is a good way to "brand" the IB schools to indicate that students who attend an IB school will have a unique experience.

The PYP program is also inquiry-based, holistic, global, rigorous and engaging for students. The IB program is noted for being student-directed. Student-direction was a widely discussed topic with some educators suggesting that the true "IB teachers" were the ones who promoted self-directed learning. These are all aspects that should continue to be connected to the public perception of an IB school.

Project-based Learning/Inquiry

The PYP program could consider a shift toward a more project-based approach (PBL) to enhance its inquiry lens. PBL seems to be well accepted in 21st Century learning context and implemented increasingly around the world. Perhaps this is because educators and the public can more easily "visualize" what PBL looks like and there is a clear inquiry process that accompanies it. Many of the teachers in this study enthusiastically described a practice that was akin to the current direction of project-based learning or PBL. The final exhibition and some of the RPATs described by the study participants could be considered PBL (for more examples see www.bie.org). To focus on PBL does not mean that you would need to abandon the transdisciplinary perspective, indeed such a perspective could enrich a substantive unit.

In particular, such a shift would mean a different emphasis in 2 areas:

1. The creation of a driving (e.g. powerful, organizing, big, essential, inquiry) question to "drive" the study. This would mean to shift the emphasis from *a central idea presented as a statement or enduring understanding* to a *question that drives the inquiry*. The question can contain the essence of the central idea/enduring understanding.

   To put this into context we used to ask curriculum designers to identify 2 or 3 big ideas and an essential understanding based on the big ideas. Then the designers were asked to create essential questions to drive the learning. We have found over time that educators worked more successfully when creating a driving question. They then simplified the process themselves by dropping the essential understanding that was implicit in the question. You might consider this approach to simplify the backward design process.

   The big question then becomes the primary organizer for the learning. Big questions should motivate students who are constantly aware of what question they are exploring throughout the unit. The question should be in student-friendly language after it has been "unpacked" by the teacher and students. A question can also be rooted in provocations and student wonderings. For smaller units, students can create their own questions and follow a research procedure to answer them.

2. A greater emphasis on the rich performance assessment task such as you might find in PBL will strengthen the inquiry process. The rich performance assessment task requires that students demonstrate the targeted concepts, skills and the IB learner profile. Criteria

for the rich performance assessment task are explicit and teachers can self or peer assess the "richness" of the performance task through a rubric such as the PYP programme of inquiry rubric on page 28 of *Developing a transdisciplinary programme of inquiry*.

Design Process

The educators in the study rarely discussed the vertical and horizontal articulation or curriculum mapping; but we think that it is essential to curriculum design. This is particularly true for schools that need to align with mandated outcomes beyond the IB program. This process is often called mapping the curriculum and is a school-wide project.

The educators did appreciate the backward design process. This should be continued.

Do continue to provide sample programs of inquiry that outline what a theme looks like from Pre K to 12 (see page 24 to 26 in *Developing a transdisciplinary programme of inquiry)*.

Scheduling

Consider addressing the issues with scheduling by recommending school administration allow for large blocks of 'unscheduled' time to implement a transdisciplinary curriculum. Many educators felt constrained by the tight scheduling of different subject areas, programs or specialist courses. The literature is clear that to effectively implement an integrated curriculum you need blocks of undivided time during the day over a period of time (Vars, 1991). Blocks of time are also needed to experience rich PBL. Another way to look at this is to consider a scheduled period of time, as the successful East Asian countries do, for student-centred inquiry in a real world context where the transdisciplinary concepts and skills are developed.

Scheduling 'inquiry periods' can be challenging, as a commitment to a transdisciplinary curriculum is needed from the administrators and the teacher as well as parental buy-in. As well, it may mean rethinking how the specialists plan and align with the PYP teachers.

Simplification of PYP planning

1. Simplify the PYP Planner. The planner needs to be a living document that teachers use on an ongoing basis and not just because they are required to fill in the boxes. Those who appreciated the planner commented that it forced backward design. At this time most people we talked to used Atlas and some are moving toward another online format. We do not understand this aspect fully and wonder about using some form of google.doc for ongoing use of planning that would be useful for teacher collaboration.

2. Don't try to calculate a balance between the transdisciplinary and disciplinary with a complicated formula. For example, on page 8 of *Developing a transdisciplinary programme of inquiry* there is the following description:

> *It is suggested that two or three subject areas that will support understanding of the central idea be identified and recorded for each unit of inquiry…. There*

> *should be a balance of PYP subject areas identified to support understanding for each transdisciplinary theme (this does mean that each subject area must be represented under each transdisciplinary theme).*

Add the alignment of the scope and sequence and any mandatory outcomes required by governing agencies to the above formula and it is easy to see why teachers might feel overwhelmed, the curriculum becomes a forced fit, students are confused and parents are unhappy. Providing teachers the autonomy to complete a minimum of 4 units of year up to a maximum of 5 should deal with the issue of disciplinary versus transdisciplinary. The more comfortable a teacher gets with integrated approaches and how much their students need to know disciplinary knowledge and skills, the easier a natural balance will be.

3. Consider an umbrella or bridge as a graphic organizer to begin the planning; here teachers decide/record what the concepts, skills and ways of being will be targeted (see, for example, Drake, Reid & Kolohon, 2014). For us in our role as teacher educators, we use a KNOW (concepts or Big Ideas), DO (interdisciplinary procedural skills such as communication and BE (learner profile attributes). We find the Know, Do, Be (KDB) is a simple way for educators to make sense of the curriculum demands regardless of geographic location or particular curriculum mandates.

   The first task of backwards curriculum design is to articulate the KDB. What is most important for a student to know, do and be at the end of this unit? An overarching graphic on a planner can help insure alignment with the summative rich performance assessment task (second step of backward planning) and the daily activities and assessments that enable students to demonstrate what they are intended to KDB (third step in the planning). This graphic might be used instead of the one on page 9 of *What is an IB Education?* (2012).

4. Consider eliminating the difference between key (transdisciplinary) concepts and related (disciplinary) concepts. Form, function, causation, change, connection, perspective, responsibility are identified as key concepts and defined as transdisciplinary. So far, so good. But then selecting a related concept(s) from the subject areas seems unnecessarily complex. As well, diversity, culture, continuity, progress, technology, representation, control, tension and flow were identified as related concepts but seem as abstract as the key concepts and indeed can be found in many disciplines. As well, the arrows are far too complicated in Figure 5 on page 11 of *What is an IB Education?* We think this description of the process might be too complex for even the DP program.

   Teachers did talk about disciplinary concepts and planned around the 6 central ideas but rarely differentiated between key and related concepts. This focus on disciplinary concepts tended to keep them focused on the disciplines rather than on what is connecting them.

   Consider using the term big idea. Several teachers also used the term “big idea” to refer to either the central idea or a key concept. This is more contemporary language that most

people understand as opposed to considering the complexity of a transdisciplinary concept.

Reduce the number of concepts to be addressed. We have found that streamlining to one or two Big Ideas or key concepts cut across the disciplines and act as a bridge to connect them is effective. Less is more.

We have found it useful to recognize that most concepts will come from science and social studies and literature while language arts, math and the arts are often used as process skills. For example, sustainability, change, interdependence, structures are found in science, social studies and in some literature. (Some will argue that they can also be found in the other subjects, as well, but we have found these more difficult to address in units of inquiry).

Language arts is used to read write, listen and present what you are learning. Math is often used for data management – even in at primary level. The arts can be used to present the learning. Specialists can resist this categorization as mentioned in the literature review. In our experience, however, this advice has helped to clarify big ideas for curriculum designers. This does not mean that the process subjects are short changed, as the skills are still taught explicitly.

The first two columns in the chart below are on page 14 in *What is an IB Education?* The first 2008 column was revised in 2012 to be more value free. (We tend to disagree with the concept of a value-free central idea although we agree with the notion of it being open-ended). There are several key concepts and related concepts. Lines of inquiry are deliberately written as statements rather than questions in order to develop conceptual understanding.

We added a third column to illustrate what a revision in the direction of PBL might look like. Note that there is an Inquiry question rather than a Central Idea and 3 Key Concepts act as the Big Ideas. One of those key concepts is well-being – a concept that was introduced in the central idea in 2012 but was not further explored. For us, if a Big Idea is in the Inquiry Question or Central Idea it needs to be explored.

Who we are – 4 to 5		
2008 p.14	**2012 p. 14**	**Conceptual PBL Focus**
Central Idea: Friendships enrich our lives and require nurturing in order to develop.	**Central Idea**: People's relationships with each other can have an impact on their well-being**.**	**Inquiry Question**: How do our relationships impact our well-being?

Key concepts: Causation, responsibility **Related concepts**: Conflict or co-operation, Interdependence. **Lines of inquiry** • How friends are made and kept • Why friends are needed • Characteristics that develop healthy friendships	**Key concepts:** Function, connection, responsibility **Related concepts**: co-operation, friendship, balance **Lines of inquiry** • How we develop relationships • How relationships affect us. • Roles and behaviours within relationships	**Key concepts:** Relationships, Responsibility, Well-being **Related concepts**: NONE **Lines of inquiry** • What does well-being mean to you? • How do different relationships affect well-being? • What is your responsibility in a relationship?

Skills: The procedural steps for different skills should continue to be identified (and posted in the room as one teacher did). This is particularly true for the inquiry process (and if you adopt a PBL focus). It seems helpful to be clear with students when they are practicing different skills such as communication and problem solving so they know exactly what is expected of them. Teachers might wish to co-create assessment tools with students to insure buy-in and common understanding.

The Reflection piece should definitely be continued. This is aligned with the new interest in metacognition and student success. The student voices in the Research section indicate that the refection on the process has been very helpful for the students.

BE (Values/Attitudes) – The IB Learner Profile seems to be well understood and used appropriately in context. It is a really strong way of addressing the whole child and should be continued. You might want to add this explicitly to the planner rather than having it hit or miss. It could appear with the Know and the DO on the overarching graphic should you choose to use one. On the other hand, the attempt to make the planning value-free seems to us to contradict the emphasis on the Profile of the Learner and the preferred attitudes that the IB program would like developed in their students.

Understanding of the PYP program

The teachers who seemed to have the deepest understanding of the PYP program described their programs as "integrated curriculum" – a term used in the literature, but does not seem to be used in IB PYP materials. Lack of clarity around definitions of integration was identified as a major obstacle in the literature review. It might be useful for teachers to have a deeper understanding of degrees of integration so that they can identify their own level of implementation and how they might use different levels at different times. Math, for example, may need to be taught as a single discipline at times and then can be more authentically integrated with other subjects in a real

world context. (This happens in many contexts where curriculum integration is effectively implemented).

Collaboration

Collaboration was well received. This aspect of the program should continue. Rich opportunities for collaboration were often scheduled. Teachers and co-ordinators met at regular times. Time was not necessarily an issue, but complaints surfaced about the quality of the collaboration. Specialists who valued collaboration often felt that they did not have a voice in the process. Indeed when they came to a meeting they would be told what the teachers had planned and asked to figure out a way to fit their subject in. The role of the specialist needs to be reviewed and if the subject area is to be included in a natural and deep way the specialist needs to be at the designing table.

Assessment

What is missing for us in this discussion of transdisciplinarity is an in-depth discussion of what assessment in such a program looks like. How is conceptual growth measured? How is transdisciplinary skills development measured? How are the attributes of the learner profile measured? We got some answers to these questions but suggest that this be a focus for future work.

For us, curriculum, assessment and instruction should be seamless and any discussion on curriculum integration needs to involve assessment of some kind. We promote the new emphasis on assessment for learning (AfL) and believe it fits well with the IB framework. Giving feedback that enhances both student and teacher learning is a skill that needs understanding the concept of growth mindset (Dweck, 2010) and how feedback affects the learner (Hattie, 2012; Earl, 2014).

Students can help to develop assessment tools (rubrics, learning goals, success criteria).

Technology

Although we did not ask questions on the role of technology, it seems that integrating technology into teaching, learning and assessment is essential for a transdisciplinary program in the 21st Century. The research on educational reform states that technology is a part of the world we live in and it is ignored at our peril (see, for example, Fullan, 2013). It is likely that most of the PYP students will have personal access to a device. At the time of this writing educators around the world are exploring how to integrate technology into the curriculum so that it enhances the learning. Good pedagogy always comes first. Many classrooms are allowing students to use personal devices as a computer in their pocket instead of trying to ban them for classroom management. Students can use them as learning and research tools. Teachers can also use them for organizational purposes, to keep parents apprised of what is happening at school and especially to follow their own child's ongoing progress.

Student-centred Pedagogy

As mentioned previously, and demonstrated in the study results, many participants believed that more opportunities for student-directed learning needed to be provided in the PYP. As we suggested above, incorporating more of a PBL focus into the program would be a good way to practise more student-centred pedagogy. Another way would be to endorse, or mandate, what some of the participants in the study were already doing: Genius Hours. Allowing 20% of a student's week to be dedicated to their own inquiry, sort of like mini-exhibitions, would dramatically increase the transdisciplinary nature of the PYP and, looking at the findings in the literature review, would likely increase student engagement, student motivation and student outcomes.

One study participant had an interesting way of increasing student-led inquiry: Hold an exhibition in every grade. Make it the culminating assignment of the year, a way for students to demonstrate all they have learned in their grade through the completion of an authentic, challenging inquiry that they designed themselves with their teacher's guidance. This would also fit in well with a PBL focus.

Professional development

1. We appreciate the structured PD program that is now in place. Indeed it seemed that the more "educated" a PYP teacher was in the PYP concepts, the more that they understood the program and how it could be implemented (although this is probably true for professionals in other systems too). Revising it slightly, however, by providing more hands-on training and finding a way to disseminate the information provided more widely and accurately should be something IB undertakes in the near future.

2. We recommend the accessibility of more "stories" of what a PYP program looks like in a successful practice. Participants suggested that they would like to do observations of others. This might involve other practitioners on their team or the consultants could do some model lessons. Stories of successful IB practitioners can be published. Videos can be shared and classroom observations encouraged. The social media can be a powerful tool. Encouraging teachers to blog can be helpful. They can meet on the twitter chat (#PYP) or creating webinars and share them. In some boards we know there is an ongoing storyboard that features a teacher and his or her good practice on a regular basis. You should be able to see an example at http://web.deltasd.bc.ca/. Participants also suggested virtual tours of classrooms on Skype and Job-Alikes where different schools would offer to share what they are doing in the field at an informal conference.

3. For many, the IB network would be stronger with the hiring of more PYP-trained teachers. Clearly, if teacher candidates had the opportunity to specialize in IB training this would be a real boon. Programs such as the partnership with the University of British Columbia should be encouraged and more partnerships developed with more faculties of education. From our teacher education perspective, a prospective teacher would greatly gain from having IB training – whether or not he or she ended up in an IB school.

Alignment of the curriculum from PYP to DP

Some IB educators wished to see alignment throughout the program from PYP to DP and were eager to see upcoming changes from this perspective. This alignment meant that the curriculum was spiraling; students would see both concepts and skills again and again but in a more sophisticated way.

We realize that the MYP direction has recently shifted and that the recommendations below may not align with current MYP reform. Still we wonder if some of the suggestions below may also be useful for the MYP and DP programs. In our experience "less is more" and some of the current examples offered in the PYP program literature are sophisticated enough to promote deep learning in the DP program.

Annotated Bibliography

Source	Annotation
Aikin, W. (1942). *The Story of the Eight-Year Study.* New York, NY: Harper.	This book, which is the first in a five volume series, provides a detailed account of the ground breaking experimental project led by the Progressive Education Association. At the time, the current high school curriculum was largely predicated on a college-preparation model, but since only one out of every six students continued to college, the majority of students' needs were not being served. This study aimed to change that. In a scenario that is unlikely to occur today, students from 30 secondary schools were exempt from traditional college admission requirements, enabling the schools to take risks and implement various educational reforms. The remainder of this well-written, if lengthy, book serves as introduction and summary of the study and its results, many of which are expanded upon in volumes two through five. This specific volume introduces problems with the existing curriculum, documents challenges schools faced at that time, outlines unique structures adopted in the wake of increased curricular flexibility, and discusses the importance of democracy in the school environment. A discussion of practical changes that were implemented is also provided, including how the schools developed their own core curriculum and how this curriculum often involved more unified and integrated approaches. Students also engaged in sustained, individual examinations of topics of their choosing, and attempted to solve meaningful and holistic problems that extended well beyond one traditional academic subject, sometimes providing integrated work experiences that allowed students to move beyond the classroom into various occupational settings. However, this revised curriculum was not strictly vocational, as gifted students, both intellectually and artistically, were challenged and offered adapted work based on their individual needs and interests. Changes moved beyond what was learned (curriculum) to include the ways of learning (pedagogy) and methods of measuring, recording, and reporting student progress; a detailed description of each of these aspects is also presented.

	Finally, it is critical to understand how students from these secondary schools fared at college, especially in comparison to their counterparts who progressed through traditional high schools. Through the study of 1,475 matched student pairs, a list of 18 student outcomes were reported, including earning a slightly higher grade average and receiving slightly more academic honours. A variety of additional analyses were also conducted to rule out plausible alternative explanations for students' successes. This is a seminal study in experimental educational reform, with the potential to radically change the structure of high schools. Given the length of this book, it likely will not appeal to many classroom educators, but those who are interested in enacting education reform would be well served by having an understanding of its progressive aims and outcomes.
Beane, J. (1991). The middle school: The natural home of integration. *Educational Leadership, 49(2),* 9-13.	Using a puzzle metaphor, Beane (1991) argues that it is critical to understand the overall picture and not simply the component parts; dividing curriculum into individual subject areas causes artificial distinctions, limiting students' ability to understand broader meanings. Suggesting that traditional subjects are actually spaces carved out by academics for their own purposes, Beane advocates for an integrated approach, which must be created in such a way that young people can see themselves represented in the curriculum. There is a strong focus on justifying why, given adolescents' desire for self- and social-meaning, an integrated curriculum is appropriate for middle school students; a rationale is also given for why middle schools, as opposed to other levels of education, are an ideal place to introduce an integrated curriculum. Beane, a well-known scholar in the field, provides support for his opinions by offering possible curriculum topics and uses examples from middle schools in the United States of America that have implemented integrated approaches. These explanations and examples may be particularly interesting to teachers and administrators working at the middle school level. Although five features of Beane's vision for an integrated curriculum are provided, adding empirical findings, especially related to concrete benefits experienced by students using an integrated curriculum, would strengthen this publication.
Clausen, K. & Drake, S. M. (2010). Interdisciplinary	The authors provide an extensive review of interdisciplinary practices in Ontario, Canada. There is a

practices in Ontario: Past, present, and future. *Issues in Integrative Studies, 28*, 69-108.	focus on exploring the current state, revisiting the past, and predicting the future of interdisciplinarity and education more generally. This comprehensive review traces nine distinctive policy shifts over 150 years and details the repeated implementation and removal of reform efforts and curricular changes. A useful comparison of the characteristics of traditional versus holistic education is provided, which could be applied beyond this geographical region. Many specific examples of integrated approaches are taken from public and private elementary and secondary levels, and could serve as a starting point for educators to conduct their own further reading and examination. Educators at all levels will find this review to be very complete and worthwhile.
Fenwick, A. J. J., Minty, S. & Priestley, M. (2013). Swimming against the tide: a case study of an integrated social studies department. *The Curriculum Journal, 24*(3), 454–474.	In this study, the authors conducted a qualitative, case-study analysis on a Scottish social studies department. Unlike many schools, where academic departments may be segmented and competitive, this secondary school has embraced integrative curriculum. Four key factors related to departmental culture contributed to the successful integration: leadership and ethos; teacher identity; departmental ethos and relationships; and space and curriculum architecture. The study mentions practical concerns such as the delivery and ownership of curriculum, and makes links to key reform policies; educators may find these aspects useful. Detailed quotations from teacher participants, which are woven with relevant academic literature, provide support for the authors' findings. Although participants acknowledge unique contextual factors that may prevent successful replication in other schools, educators who are thinking of implementing integrated curriculum in high school settings may nevertheless find this study beneficial; the results may also extend beyond the specific academic departments discussed herein.
Hardman, M. L. (2009). Redesigning the preparation of all teachers within the framework of an integrated curriculum model. *Teaching and Teacher Education, 25*(4), 583–587.	Hardman examines the redesign process of a teacher education program in a US university. Given the many educational reform attempts worldwide, changes must also be made to the ways future teachers are educated, as these individuals will eventually be responsible for adopting an integrated curriculum. The redesign process followed an integrated curriculum model and was guided by nine basic tenets. The vision and conceptual framework for the redesign is also provided. Because of its specific focus on teacher education programs, this

	article may appeal to a more narrow set of educators who are interested in teacher education or higher education.
Hayes, D. (2010). The seductive charms of a cross-curricular approach. *Education 3-13: International Journal of Primary, Elementary and Early Years Education, 38*(4), 381–387.	This article focuses on one recommendation, namely cross-curricular approaches, from the influential Rose Review, which examined primary school curriculum in England. Hayes is optimistic about implementing a cross-curricular approach to learning, but still presents a balanced examination of possible advantages and concerns associated with adopting such an approach. Various definitions, foundational concepts, and selected theorists are introduced, making this short piece a nice introduction to the cross-curricular approach in English contexts. The author concludes by highlighting that curricular reform of any sort provides an opportunity to consider the overall purpose of education and implement appropriate changes accordingly.
Parker, J., Heywood, D. & Jolley, N. (2012). Developing pre-service primary teachers perceptions of cross-curricular teaching through reflection on learning. *Teachers and Teaching: theory and practice, 18*(6), 693–716.	This small scale empirical study explores pre-service primary teachers' initial and subsequent perceptions of cross-curricular teaching and learning in the United Kingdom. Pre-service teachers generally held positive beliefs towards cross-curricular teaching and learning, but developed increased criticality towards cross-curricular approaches as they reflected on their own cross-curricular art and science learning experience. Although the study is well-written and follows sound methodological principles, it is important to note that it is not based on pre-service teachers' actual experiences in the classroom but rather on their beliefs pertaining to cross-curricular teaching and learning.
Vars, G & Beane, J. (2001). Integrative curriculum in a standards-based world. *Eric Digest*. Retrieved from: http://www.ericdigests.org/2001-1/curriculum.html	Citing an increased interest in integrated curriculum and an increased focus on standardized reform, Vars and Beane (2001) provide suggestions for how to successfully merge the two (perhaps seemingly incompatible) curricular approaches. The authors offer a useful description of strategies, such as creating a "back map," that teachers may adopt to show how an integrated curriculum can cover the same material that would be included when teaching discrete disciplines. However, the article uses highly technical language and acronyms that may alienate many practitioners. This article may be of interest to those who wish to implement an integrated curriculum but are simultaneously forced to work within a standardized, subject-centred curriculum.
Wallace, J., Sheffield, R., Rennie, L. & Venville, G. (2007) Looking back, looking	Although many positive outcomes are attributed to curriculum integration, this curricular approach has not necessarily been systematically adopted in Australia or

forward: Re-Searching the conditions for curriculum integration in the middle years of schooling. *The Australian Educational Researcher, 34*(2), 29-49.	elsewhere. The authors re-examined data originally collected in 1996, and followed up with these same schools 10 years later in order to examine factors that facilitate and inhibit the implementation of integrated curriculum; how these factors contribute to the sustainability of integrated curriculum approaches was also examined. Supplemental interviews with practising teachers provided further support. The authors identified four factors that facilitated and four factors that inhibited integrated curriculum implementation and sustainability, and six structural characteristics that appeared to be common in most of the successful schools. They conclude by hypothesizing possible reasons for the resiliency of some schools' integrated curricular approaches. The authors caution against simply striving to incorporate a list of program characteristics, as the successful outcomes may be synergistic. While the lists of factors and characteristics are not prescriptive, these findings may be very useful for educators looking to implement or sustain integrated curriculum, especially in middle school settings. Educators may see aspects of their own educational context represented in the school or teacher profiles, and could work to adopt the findings in their own educational settings.
Zhbanova, K. S., Rule, A. C., Montgomery, S. E., & Nielsen, L. E. (2010). Defining the difference: Comparing integrated and traditional single-subject lessons. *Early Childhood Education Journal, 38*, 251-258.	This mixed-methods study compared teacher talk and actions in classrooms with an integrated curriculum to classrooms with a traditional, separate subject curriculum. In the integrated curriculum classroom, the observed teachers were 24 pre-service first and second grade teachers and in the traditional curriculum classrooms, the observed teachers were two experienced, first and second grade teachers. This American study reports on differences in instructional methods, motivational techniques, questions posed by teachers, structure of the lessons, and the roles of the teachers and students across the two conditions. This information may be useful for educators looking to adopt an integrated curriculum, as it could be translated into practical strategies and techniques. By reviewing relevant literature and offering a detailed description of the research setting, the authors provide a theoretical and practical focus on art integration, which may be of particular interest to some educators.

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Appendix A: Letter of Invitation and Informed Consent

Date: November 7, 2014

Project Title: An exploration of the policy and practice of transdisciplinarity in the International Baccalaureate Primary Years program.

Principal Investigator (PI) Susan Drake, Ph.D

Professor

Faculty of Education

Brock University, sdrake@brocku.ca

Co-investigator: Michael Savage, Ph.D

Assistant Professor

Faculty of Education

Brock University. msavage@brocku.ca

INVITATION

You are invited to participate in a study that involves research. The purpose of this study is to explore how transdisciplinarity in the IB Primary Years Program is being articulated in policy and translated into classroom implementation. This study is being funded by Programme International Baccalaureate Organization.

HOW YOU WERE SELECTED TO PARTICIPATE IN THIS STUDY

The International Baccalaureate (IB) Head Research Office contacted all the IB schools globally who have been running the Primary Years Program (PYP) for longer than 5 years asking their principals if they wished to have their teachers take part in this study. Your principal agreed. IB's Head Research Office then sent a list of schools, organized by geographic subregion (e.g. South America) and type of school (private or public) whose principals had agreed to participate to the researchers. The researchers then randomly chose, using random number generation, one public school and one private school from each of the 6 geographic subregions. Your school was one of those randomly chosen. The researchers then asked your school's IB School Coordinator to send this letter to you.

WHAT'S INVOLVED

As a participant, you will be asked to participate in a Skype interview which will be audio-recorded and transcribed. The transcript of your interview will be sent to you so you may review it for accuracy and so you may provide any clarification you wish to regarding your statements in the interview. You will also be asked to provide sample of your curriculum planner. If you have a blog or class website/wiki we invite

you to share that too. We will send you a narrative that we have constructed from your interview to capture your teaching experience. You may add or delete from that narrative until you feel it accurately reflects your experience. We may ask for a further Skype conversation if necessary and acceptable to you. Or you may ask us for a further conversation. Participation will take approximately 2 to 3 hours of your time.

POTENTIAL BENEFITS AND RISKS

Possible benefits of participation include the opportunity for personal reflection on your own practice and to contribute to the knowledge base on transdisciplinary practice. How to best educate students in the 21st Century is an important global question and your experiences will help educators to understand this issue globally. You may feel some pressure to participate in this study as it is being initiated by IB's Head Research Office but we would like to assure you that no information about participants will be shared with your school or with IB's Head Research Office. The only people who will know who participated in the research will be the members of the research team. Additionally, no information that could be used to identify you (such as gender, age, ethnic origin) will be collected or reported. We will only be reporting the geographic subregion your school is located in, the type of school you teach in (public or private), the number of years you have been teaching, and whether you use English-language versions of IB's curriculum materials or a translated version. As a result, participation in this study is voluntary and you should not feel obligated to participate. Additionally, you may withdraw from the study at any time, with no consequences or penalties to you for withdrawing**.**

CONFIDENTIALITY

The information you provide will be kept confidential. Neither your name nor any identifying information about you will appear in any report or published work resulting from this study; however, with your permission, anonymous quotations may be used. Shortly after the interview has been completed, we will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points that you wish.

Digital audio recordings of participant interviews will be transcribed. Once transcription is complete the digital audio files will be deleted from the recording device. Any back-up files will also be deleted at this time. The electronic transcripts will be kept on a password-protected computer in a locked office at the researchers' location. Paper copies of transcripts will be stored in a secure locked office at the researchers' location. Data will be kept for the duration of this project until July 30, 2016 after which time data will be confidentially shredded and deleted. We expect to publish these results after the project. You will receive an executive summary of the results of this study approximately in June 2015. If you wish to receive a more detailed copy of the results you may request this through Susan Drake (sdrake@brocku.ca) after June, 2015.

Access to this data will be restricted to Susan Drake, Michael Savage, a transcriptionist and two research assistants.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study. Further, you may decide to withdraw from this study at any time and may do so without any penalty. In order to withdraw from the study all you need to do is contact Susan Drake (sdrake@brocku.ca) and inform her that you wish to withdraw from the study. You do not need to provide any reason for withdrawing but may do so should you wish to. Should you choose to withdraw any data you provided will immediately be deleted and/or confidentially shredded and it will not be used in any data analysis.

PUBLICATION OF RESULTS

Results of this study may be published in professional journals and presented at conferences. Feedback about this study will be available from Susan Drake at sdrake@brocku.ca

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please contact Susan Drake (sdrake@brocku.ca) using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University **[14-031]**. If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at (905) 688-5550 Ext. 3035, reb@brocku.ca.

IF YOU WISH TO PARTICIPATE

If you would like to participate in this study please email msavage@brocku.ca letting him know you wish to participate. A member of the research team will then contact you to set up a convenient interview time.

Thank you for your assistance in this project. Please keep a copy of this form for your records.

CONSENT FORM

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

Appendix B: Interview Protocol

Can you please tell us a little bit about yourself. Your experience as an educator? Experience in an IB school? Your current position?

Question 1: Can you please tell me a story of your best teaching learning experience in the IB program – a time that excited and energized you.

Question 2: What does transdisciplinary curriculum mean to you?

Question 3:

How do you approach teaching and assessing:

- Transdisciplinary themes? Central ideas?
- Key concepts, related concepts?
- Transdisciplinary SKILLS?
- The IB learner profile?

Question 4:

How do the following help or hinder the implementation of the transdisciplinary PYP program?

- the PYP planner?
- collaborative planning?
- institutional supports? Policy? Leadership?
- personal philosophies/beliefs?
- professional development?

Question 5: In five years your school is noted internationally for being the best PYP in the IB schools. What has changed?