INSIGHT AND OBSTACLES FROM IMAGINATIVE EDUCATION SCIENCE CLASSES

As an international student, I am curious to know more about IE applications in classrooms; therefore, I decided to conduct my research with IE science teachers working in Canadian schools. The purpose of this research is to find out the mot useful cognitive tools and explore some effective examples of IE in science classes. On the other hand, I wondered what are some challenges that IE teachers are facing and how are they overcoming them. In addition, I embedded a personal reflection to compare and contrast my own experience of IE implementation and my participants' experiences.

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Contents

I-Introduction

Some people think that science is hard to understand, and it is beyond their capabilities. Furthermore, they complain that Science is complicated, contains many specialized vocabularies and, worst of all, it needs a lot of memorization. Many students comment that they do not feel a sense of belonging when taking science courses and science teachers to them seem to be speaking in strange languages! As mentioned in the article *"why is it so difficult for everyone to understand science?"* One of the major problems with reading and learning science is "the strange language of science! Most people are separated from research and scientists by the vocabulary of science. All 3 main branches of science (biology, chemistry, and physics) and each of their subdisciplines use specialized terms. Scientists do speak strange languages!" (2016, para.3) Hearing these reflections from my students in my science classes motivated me to seek and implement new teaching strategies. From my point of view, applying cognitive tools of imaginative education is a perfect way of making students more engaged in learning science topics. While most of my students were very excited in using new methods and performing new activities, I had some challenges in the application of some cognitive tools. I was curious to find some ways to overcome these problems and find out the most useful IE cognitive tools in science classes. I am interested in conducting this action research to get new insights and find out the obstacles that IE science teachers in Canada face.

II-My personal location and research context

I am a science and biology teacher. I taught in Saudi Arabia from 2006 to 2018 in four different national and international schools. During the school year of 2017-2018, I used the cognitive tools from the somatic, mythic, romantic and philosophic kind of understandings for the first time. It was a great opportunity to make my students more engaged in learning. From creating images, songs, models, and collecting materials to organising data by using the literate eye cognitive tool- my students' reflections motivated me to have a deeper understanding and application of imaginative education in my classes. For instance, in my grade 9 biology class, I divided the class into three groups. One group chose to create a song, the second decided to make a model, and the third group generated comic strips. All these three groups worked on the same topic "symbiotic relationships". At the end of the science period, each group presented its outcome to the other groups and exchanged information and ideas.

Additionally, I also faced some challenges in applying some of the IE cognitive tools. Some of the imaginative education limitations were directly related to students' refusal or administration's long and complicated procedure. For example, many students did not like to role play, and they did not want to act. Some of them did not take it seriously, so other students did not listen or understand anything. The class ended up being messy and rowdy. Few students spent their time just reading the information written in their notes, so other students were bored, sleepy and did not participate at all.

Furthermore, when I proposed a field trip to the administration, it took several months to get a reply. The teachers did not have the freedom to take students out of the school or even out of the classroom without the express permission of the school administration. The bureaucracy around all this leaves the teachers feeling handcuffed and even stressed. In addition, two hours for a science class per week are not enough to accomplish many IE activities, since these two hours also include checking assignments, completing worksheets, doing quizzes, tests, exams and explaining contents.

As a teacher, when it comes to education in Canada, I have always had these questions:

How does imagination play a role in teaching science?

What is the most useful IE cognitive tools for teaching science?

How can I overcome the obstacles that arise during my practical work?

Is it easier to implement IE in Canada?

Am I facing similar problems of IE implementation as Canadian teachers?

What educational theories influenced Canadian education system before? And how did it change recently?

It is a great opportunity to interview IE science teachers and share their opinions and experiences about IE applications.

Before discussing the new IE approach, I would like to go back in history to describe how the education system changed over the last hundred years and elaborate the different learning theories dominated in Canada and in the west. One major educational theory that widely spread is progressivism. "American progressivists and educational scientists such as David Snedden, Franklin Bobbitt, and George S. Counts were promoted by the British Columbia Minister of Education, G.M. Weir, and implemented through guides such as Harrap's The Technique of Curriculum Making. In social studies, progressive education came through Harold Rugg's widely used texts, Man in a Changing Society. In the 1940s, Donalda Dickie's Canadian published, American influenced reference book on instruction, The Enterprise in Theory and Practice, became a principal source of instruction in progressive education and was used in teacher education programs at many institutions across the country." (Gemmell, 2014, p. 44). In the literature review, I will point out progressivists' perspectives and discuss their main ideas. Then, I will describe Egan's theory of imaginative education and I will figure out some IE connections with the new BC curriculum. I will end up the literature review by tracing some IE obstacles from the article "*a case study of educational change: Egan's framework and the praxis of teaching".*

III-Literature Review

An overview of the history of education

Progressivism

Progressivism represented by Spencer, Piaget and Dewey dominated in North America and spread widely in the schools during the nineteenth century. According to progressivists, education and curriculum should be based on the nature of children. Moreover, psychology was an important aspect to understand children's development and to apply effective ways of learning. As Egan claims "Progressivism has historically involved a belief in attending to the nature of the child, and consequently, its research arm (so to speak) has involved studies to expose that nature more precisely. Because the mind is prominent in education, psychology became the consistent scientific handmaiden of progressivism. The psychologist exposes the nature of students' learning or development and the practitioner then must make teaching methods and curriculum according to with what science has exposed." (Egan, 2002, p.6)

Herbert Spencer

Spencer believed that science is the root of a powerful curriculum regardless of other major studies such as grammar, history or arts. "He was an energetic advocate of science in the curriculum, joined by Thomas Huxley in Britain and Charles Eliot in the United States, and the currently common belief that science ought to have a significant place in every student's education is a mark of their success." (Egan, 2002, p.122)

Spencer emphasised the importance of concrete experiments directly related to children's life. However, he did not establish a whole detailed curriculum based on his principles. He rather suggested kind of applications and different examples to clarify his point of view. He kept the curriculum opened to children's needs and natures. "in Spencer's view, the educator's task is to aid "self-evolution", and we can easily improvise a curriculum if we remain sensitive to the nature of the child and his or her needs." (Egan, 2002, p.122)

According to spencer (Egan, 2002), children learn as going from simple to complex or from concrete to abstract. However, Spencer's curriculum was vague and he diminished the importance of teaching language and history for elementary students. The problem is not mainly related to the subject taught, but it depends on the tools used to explain the information. Egan opposed Spencer's theory saying "we should reject Spencer's knowledge-based notion of recapitulation for the further reason that it doesn't allow us to design a sensible curriculum for modern students. One cannot sensible teach about the starts, for example, by beginning with the simple views of savages and gradually elaborating them in the direction of modern cosmology. It would mean beginning with something like astrology, then giving accounts in which the sun orbits the earth, then reversing those accounts, and so forth." (Egan, 2002, p. 126)

John Dewey

Dewey's studies in education focused on changing the enforced and rigid information taught in schools to a modern way of teaching that is making learning more natural and related to the everyday environment. Dewey, like Piaget and Spencer, believed that children go gradually through different development stages and he divided them into three main stages. “The process that Spencer and Piaget characterise as moving from the empirical or sensory-motor to adult rationality, Dewey breaks into three stages. First children learn the “power to do”; second, “this material gradually is surcharged and deepened through communicated knowledge and information”; and, last, “it is enlarged and worked over into rationally or logically organized material.” (Egan, 2002, p.111)

However, students in one classroom would belong to the first, second or third stage. Therefore, teachers would face a major problem of having students with different ability levels in one grade level. As Strauss said, “students who had mastered a skill or concept reported boredom in the designed program, and students who had not mastered a particular skill or concept were lost once the teacher had completed a module. Ability grouping was proposed as a way for schools to offer students more individualized instruction”. (2013, para.5) For IE teachers, different cognitive tools belonging to different kinds of understanding would meet students needs but it requires a lot of preparation.

Jean Piaget

Another very famous progressivist is Piaget. His theory of cognitive development received great attention and is still influencing on many educators ‘practices. Piaget explained how children pass from one stage of development to another and how they acquire knowledge taking into consideration a child nature and environment. “What Piaget tried to do that Spencer did not was chart out the gradual growth step by step from the infant’s undifferentiated mind to richly differentiated adult rationality.” (Egan, 2002, p.103)

According to Piaget (Egan, 2002), teachers should master the development stages of the child in order to teach effectively. However, imaginative education approach states that the powerful teaching strategy is embedded in understanding the kinds of understanding and the cognitive tools rather than just following the biological stages of child development. For instance, a unit of motion and gravity could be taught for grade 2 using the mythic kind of understanding and drawing on tool of the romantic kind of understanding to deepen students understanding and broaden students horizon.

Kieran Egan

Kieran Egan aims to improve education by exploring students' kinds of understanding and engaging students in learning using cognitive tools. In Egan's book "*getting it from the beginning"*, although Egan agreed in some general progressivists' ideas, he criticised and tried to convince the reader of false principles embedded in the progressivism education. "So far I have tried to persuade you that progressivism got two connected things wrong. The first is the belief that in their early play and language acquisition and in picking up "streets-smarts" children demonstrate a kind of natural learning that should form a model for how teachers should engage them in learning in school. The second is the belief that the scientific study of the nature of human learning will lead to principles for effective teaching." (Egan, 2002, p.74)

According to Egan (2002), using cognitive tools makes the curriculum more meaningful and engaging to the students as well as broadening their imagination. Therefore, the learning process can be more functional and successful compared to the theory of progressivism.

By using cognitive tools such as storytelling, it relates us to other people, evokes emotion and triggers our imagination. Since the existence of human beings, stories have been used widely. In addition, it is still used and will be used in future to illustrate historical events, personal achievements, specific experiences, emotional feeling or useful information. As Egan said (1997, p.64), "we "storify" events, whether fictional, events, real, or mixed as in daydreams, in order to understand them in a particular way. Mythic understanding involves considerable story-shaping of experience so that events, facts, ideas, and people may be made affectively meaningful." In IE, stories are used to connect students emotionally with the topic taught and to evoke wonder. The scientific content would be explain to students in a narrative way rather than using once upon time story.

Like roots which anchor the tree to the ground and support it, the cognitive tools hold-up kinds of understanding. By incorporating humanisation, heroic qualities, changing of context, or literate eye, teachers are building a romantic kind of understanding. Each tool is like a root that all together makes the tree strong, fruitful, beautiful and help it to stay upright. Likewise, the cognitive tools help the students make sense of the meaning, think deeply and make the teaching process more effective.

Reflecting on previous educational theories provides the new researchers with a strong base to build on, improve or update teaching methodologies to meet students' needs. Therefore, Egan was inspired by previous theories and came up with the five kinds of understanding. Later, I am wondering how and where IE theory would meet the new BC curriculum.

New BC Curriculum from IE Lenses

New BC Curriculum	Egan's Hypothesis
"Development of communication competency begins within families, before students enter formal schooling, and expands at every level of schooling. At each stage, students maintain and enhance competencies from previous stages, while developing new skills. Students move from basic or highly supported to increasingly complex, sophisticated, and independent communication. The development of competence in communication does not end with school graduation but continues to develop in personal, social, educational, and workplace contexts." (Ministry of education)	"I want to consider the different degrees of culturally accumulated complexity in language, beginning with oral language, then moving to literacy, then to the development of systematic, abstract, theoretic, linguistic forms, and finally to habitual highly reflexive uses of language. Each of these degrees of sophistication in language development restructures the kind of sense that their users make of the world. I will investigate the implications of each of these degrees of linguistic development for kinds of understanding." (Egan, 1997, p.30)

How Does the Imaginative Education Approach Lead Up to Core Competencies in The New BC Curriculum?

A clear harmony appears between Egan's hypothesis and BC new curriculum. This new idea of education is the twenty-one-century way of teaching, and its main purpose is to add more skills to students as they grow up. By grasping the five kinds of understanding, educators orient their students to understand the real world and lead their minds to everything new. Therefore, it helps in creating good citizens and excellent communicators. In a science classroom, communication is a fundamental process to share ideas and discuss results. For instance, the equation of force is $F=m\times a$ can be better understood when students will be divided into groups to design a lab and make many trials then compare their results with other groups. In this way, students can make self-evaluation and track the errors. This is where the theory would meet the practice and connect it to real life. As Kok said, "Thus, language and communication are not just forms of expression that "convey" thoughts and ideas, but they are precisely the ingredients from which thoughts and ideas are made of. With this in mind, science communication is more than just speaking and writing fluent English or focusing on proper pronunciation and spelling. It is really about getting the students to make clear and precise scientific meanings through language. Communication and meaning making are two sides of the same coin – one cannot exist without the other." (Kok, T. 2014, para. 28)

By stimulating students' imagination, educators are encouraging students to be more responsible, creative, build positive personality, have culture identity, enlarge critical thinking and be self-aware. As Egan and Judson mentioned, "To imagine something is to think of it as possibly being so, and that an imaginative person is one with the abilities to think of lots of possibilities, usually with some richness of detail". (2015, p.3)

Imagination is linked to discovery, invention and originality because it is thought about the possible rather than the actual. Imagination is fundamental to make teaching more efficient and effective. Consequently, children will look at knowledge from different perspectives and think about it in different ways. For all of that and from my point of view, imaginative education approach shares some similarities with the requirements of the new BC curriculum. In addition, many of the participants mentioned in the interviews that the new BC curriculum is more flexible than the previous one and this flexibility allows better implementation of IE.

From my perspective, it is very challenging to implement IE in countries that use the traditional way of teaching and oblige their students to do many standardized tests. This rigid educational system makes it very challenging to implement IE. Teachers feel stressed about students' achievements and scoring in the tests. Therefore, teachers focus on lecturing, memorization and testing strategies. As Gillmore mentioned, "Many teachers acknowledge that comparative assessment techniques, such as standardized tests, often measure performance more than knowledge. Students may recite information but have little ability to apply it to their lives. This can frustrate teachers, who may feel these systems can't be changed". (2018, para.1) Countries that aim to improve their educational system and implement new approaches such as IE should make a change or a balance between tests and learning activities to get high results.

Imaginative Education and Science

As Schulz (2009) mentioned, a firm scientific theory can be deeply understood by using humanization and role play. Moreover, students' curiosity would increase, and their wonder may arise. Therefore they will start asking many questions such as who discovered it? How did they formulate it? What are the advantages of this discovery? What are the limitations? Although many people think that imagination is restricted to art and music, it plays a fundamental role in all subjects' areas including science. If scientists did not use their imagination, they would not be able to come up with any thing new. If Newton did not imagine the reasons behind the falling of the apple, we would not know about the gravity and laws of motion. If Darwin did not imagine how species change over time, we would not be able to discuss bacterial resistance.

An example of an effective way of teaching the biodiversity topic for high school students is using a role play activity. This method was developed by a researcher from Roger Williams University (Davis. C, 2018). The high school students acted like the species in the ecological web. They gathered information about the different species present in the ecosystem. Whether simple or complex, high school students were able to differentiate between the kinds of interactions that would exist in a real ecological web. In addition to being engaged, searching for connections was a successful way to install the sense of wonder in the students, and it activated students' curiosity to answer many questions about ecology. The power of imagination is essential for theoretical advances in science.

What Are Some IE Challenges?

There are several challenges that limit the application of IE in classrooms. "This section begins to more specifically address the primary focus of this research-what has been problematic in educators' experiences with Kieran Egan's work- by examining several themes found in the data set relating to possible constraints to imaginative education often viewed as being external to the educator. These themes, or possible constraints, include time availability, curriculum requirements, evaluation requirements, student differences, and resource availability." (Fettes, & Mckenzie, n.d, p.8)

The main obstacles that some of these educators described in the article "*a case study of educational change: Egan's framework and the praxis of teaching*" are the following:

1. Time availability

Educators do not have enough time to plan units or lessons including cognitive tools and they said they might need months or even years to prepare all the curriculum according to IE. In addition, they mentioned that they lack time to read all Kieran Egan's books to understand his theory deeply.

2. Curriculum requirements

Some educators mentioned that it is so difficult to cover all the curriculum needed in the school and implement IE at the same time.

According to the new BC curriculum, most teachers said that this problem is solved as they have more freedom to cover the topics.

3. Evaluation requirements

"Evaluation is probably the greatest challenge and certainly one I have not yet solved. This is because much of what we are trying to evaluate is abstract and subjective. I cannot really talk about evaluation because I need help with it! I have used these methods in three schools –two private schools and one government school. I gave up using the model in the government school since it caused so much angst amongst parents who could not see how teaching in this way met the government's education standards. In the private schools, I have been supported. However, there is always a lot of pressure on being accountable – especially in the upper primary years, and Egan's model is a model that cannot be easily assessed. Designing meaningful and authentic assessment tools for Egan-based units will be a big breakthrough." (Fettes, & Mckenzie, n.d, p.10)

4. Student Differences

Different cultures and languages have a great influence on the understanding and application of Egan's work among students. Coming from a rigid and traditional classroom to an imaginative education one would cause a big dilemma because students may think that it is a perfect place to play. Teachers must elaborate on lessons' objectives and emphasize on activities' purposes. In addition, students who speak a different language and struggle with the language spoken in the class will not understand what is happening in the classroom.

5. Resource availability

"A number of resources were mentioned in the data set; these resources include collaboration, summarized reading material, online resources, and workshops. A number of educators emphasized the importance of opportunities for collaboration in their efforts to work with Egan's ideas. The comments of the educators suggest that the collaborative relationship could be with fellow teachers, with administrators, or with people external to their school." (Fettes, & Mckenzie, n.d, p.12)

In this case study, many educators pointed out on the importance of working with an imaginative educated partner in schools or to having an imaginative education community where they can discuss their thoughts, challenges and inspire each other.

Compared to my results, some challenges are similar while others are different. More information will be found in the results and analysis part.

IV-Research Ethics

I completed the course in research ethics to be able to work as a research assistant in the educational faculty at SFU. Here is the link: https://www.sfu.ca/ore/EducationTraining.html . I have completed the tri-council policy statement: Ethical conduct for research involving humans on December 12, 2018. I received a PDF completion certificate, and it is attached in the appendices.

Moreover, my colleagues and I had the chance to have a representative from the ethics research department on Jan 11, 2019, to know precisely how to protect human participants and to be familiar with the process of getting informed consent from the participants.

The participants signed the consent form. In addition, anonymity of the participants was strictly maintained and any data collected was labeled with an anonymous participant ID. All electronic data collected as part of the study was kept in a password protected file in my computer. Once the interviews were transcribed, I deleted all the recorded interviews.

V-Research Site

Since I moved to Canada the last September, I have been curious to know how teachers teach in BC schools. During the research, I took a break from teaching and interviewed several IE teachers with a BC Canadian schools experience.

A total of seven IE teachers participated in generating data as a base for this actions research project.

Ava→ High school (grades 11, 12)

Emma→ Elementary (grades 1, 2)

Isabella→ Elementary (grade 6)

Dania→ Elementary (grades 5, 7)

Lama→ Elementary (grade 5)

Leen→ Elementary (grade 2)

Mia→ Elementary (grades 2,5,6)

VI-Methodology

A qualitative research methodology was used in this action research project to collect data, analyze the data and generate a conclusion with regards to insights and obstacles from imaginative education science classes. To come up with detailed information, I used interviews as a data-collection method to hear every teacher's experience and to understand every teacher's point of view.

"Researchers use interviews to allow participants to share their situations, and to give each person a voice and opportunity to be heard." (Parsons, J., Hewson, K., Adrian, L., & Day, N., 2013, p.55)

"The point of an interview is to gain each participant's perspective" (Parsons, J., Hewson, K., Adrian, L., & Day, N., 2013, p.56)

Hearing the experiences of different IE teachers provided me with sufficient information to make a detailed description of the challenges that many teachers face when implementing IE in science classes. Therefore, my aim in this report was to find some solutions or suggestions to overcome these problems.

With the help of the professor Gillian Judson, I contacted eight teachers working with Kieran Egan's imaginative education framework. Of these, four were available for interviews. In order to have a strong base to start with my report, my instructor Michael and I decided to ask my colleagues to be participants, too. Additional three interviews were made from members of my cohort. A total of seven interviews were carried out successfully. Six out of seven participants are elementary teachers, and one is high school science teacher.

All interviews were recorded either by Skype, zoom or phone. Two participants wrote the answers to the questions and sent them by email. Before starting the analysis, all the interviews were transcribed and pseudonyms were given to all participants. Finding similarities among the answers was a key component to make a generalization at the end of this research.

Validity

In the qualitative research, checking validity is essential to draw a valuable conclusion. I used effectively two strategies to prove the validity of the research.

- Rich Data

Transcribing the five recorded interviews and having the two written answers attached in the appendices of this report provided me with rich data. In the results, I analyzed the information from my own lens and included some quotations and notes that support my point of view. However, all the detailed interviews are being written to allow the reader to look at the information from multiple perspectives.

“Both long-term involvement and intensive interviews enable you to collect “rich” data, data that is detailed and varied enough that it provides a full and revealing picture of what is going on. In interview studies, such data generally require verbatim transcripts of the interviews, not just notes on what you feel was significant.” (Maxwell, 2013, p.126)

- Quasi-Statistics

"Quasi-statistics not only allow you to test and support claims that are inherently quantitative but also enable you to assess that *amount* of evidence in your data that bears on a particular conclusion or threat, such as how many discrepant instances exist and from how many different sources they were obtained." (Maxwell, 2013, p.128)

In my results, I counted the number of teachers with similar answers, and I expressed them in a bar graph figure. I believe that this quasi-statistic gave me a strong base to build on my conclusion later on.

***VII*-Results and Analysis**

Why IE?

All participants are IE teachers, and they are already implementing an imaginative education approach in their classes, but I wanted to know what first attracted them to study and apply this framework.

Most of the teachers answered that they were searching for a new methodology to engage their students and to make the material more interesting and fun for the students. Additional comments were made on how this new approach made information more meaningful to students and connect the students emotionally to the topic explained. Leen explained,

> "I like the connection to the story and helping give a human connection whether be a scientist or something like that, that is making it more meaningful to them rather than just facts. And also, give them an application to real life so you can use a metaphor, tools, and even games to make it look more than just memorizing facts and science. Flexibility to meet the needs of

different students is also important so that you can teach in different ways that the students can access science and understand it."

A common purpose existed for all the interviewed teacher who were willing to be more creative in their classes and make the learning process more effective and efficient.

One further reason that attracted one teacher to enrol in this program was its flexibility as having part of it online and especially running classes during the weekends. My personal story with IE will come up in the personal reflections and discussion part.

Participant understanding of "kinds of understanding" and "cognitive tools."

Many teachers emphasized on the important to explore each student's kind of understanding to engage him or her in the lesson and to use the appropriate tool matching with this kind of understanding. Cognitive tools shape students' thinking and help them to make sense of the world. An infant cannot be taught ironically for example because he or she did not develop the literacy to cope with an ironic understanding. However, with the somatic understanding and with the usage of the five senses, this infant would grasp knowledge about the real world surrounding him or her. As students' minds are re-shaped by cognitive tools. Therefore, students' kind of understanding would change from somatic to mythic, romantic, philosophic till reaching the ironic. Isabella explained,

"I see the kinds of understanding the way Egan describes it: the way a holograph is built, plate by plate making a picture more and more clear. Or like zooming in on the details of a flower to get a clearer picture of what it is made of. When we are first born, we see the flower as its basic shape (Somatic). As we grow and learn the language, we start to see the flower as a set of petals, a stem, and leaves (Mythic). Then as we learn to read, we discover that flowers have roots and they need water and nutrients (Romantic). And then we learn that the flowers use carbon dioxide to create oxygen and undergo photosynthesis (Photosynthesis)"

I really like this metaphor of the four kinds of understanding but I think Isabella didn't mention the gains and losses that would occur when going through the kinds of understanding. I would add to the example, when learning and thinking about the process of photosynthesis from a philosophic kind of understanding, students would go deeply into how the process occurs rather than touching or smelling the plants' leaves. Students would crave for generalization and forget about senses. Although they are gaining tools from the philosophic kind of understanding, they would lose some tools from the somatic, mythic or romantic kinds of understanding.

Lesson Plan

When I asked the teachers about how they plan their science lesson using a cognitive tool approach, five out of seven said that first of all; they search for the story. It does not mean to start with "once upon a time". It would be an accidental discovery, human story, events, or kinds of relationship. Ava mentioned,

When I was planning my lessons, I look at the topic, and first of all, I would find the narrative in that topic. Everything with me started with a narrative, and by narrative, I do not mean telling a historical story of how things developed. For example, let us take an example of a real-life thing about let us say chemical bonding. The narrative in chemical bonding is that everything

wants to connect except for the noble gases like helium and neon and so on, everything else wants to connect with something else. So, it is all about relationships between metals and nonmetals, between two different nonmetals but at the bottom of it is the connection or the relationship between them……….
Is there any set of tools that would work better for that? There is something else like when you did different topic a whole other set of tools and the trick is as a teacher would be able to recognize which tool would work best with which topic."

Moreover, Lama said,

So, in the story of Newton, he becomes not this old dusty scientific figure but he is somebody who enjoyed and suffered things that are similar to them and all of a sudden, he becomes more of interest, and he is more relatable. So, the story of Newton was first used to pull them in. So, first I look to the story. Other time, I look to hero quality that something that they really care to be like then I can pull them up from this.

One teacher said that she usually starts with a heroic quality and another mentioned that she always searches for the tools that will engage her students and she insisted on what can keep the students engaged. Some of these powerful and effective tools will be mentioned in the next part. I noticed something very important that teachers seem to check the students' abilities and interests each year and try to edit the lesson plan accordingly. Being flexible and adaptable will help in the development of the students' kind of understanding. Now, I believe that I made a big mistake in my teaching experience. I thought that if I understood the content and I prepared the lesson, then

I can use the same type of preparation for many years to come as a teacher. Classes are dynamic and students are changing. They might not have the same interests or like the same tools. What I discovered through time and especially when I started my masters' degree is that lessons would be adjusted every year according to meet students' needs. For example, if my previous students engaged in making a role play of the immune system-first, second and third line of defenses doesn't necessary that my current students would enjoy it. They would prefer to make a metaphor project and find it a more engaging activity than making a role play. Although the cognitive tools are somehow universal, its applications would be directly related to students' interests and levels to make it more productive.

What Works in Science Classes?

The participants had different answers regarding this question. Here are a few examples of what best works for the interviewed teachers.

a. In science, somatic kind of understanding can be widespread when doing a scientific experiment. Students can smell, touch, see, hear or taste to engage them in the lesson and stimulate their curiosity to explore how, why and what happened during this lab experiment. Ava said,

> "In science, I always find that it is useful to start with something somatic. So, I would start with the students engaging in a little activity. They take a piece of copper wire, put it in a Bunsen burner of flame. They see the green colour coming off of it then it turns to black then the question runs in their minds is how does it do that? That always elicit a really strong somatic response from the students because they are surprised when they

> see the bright green flame and then they got hooked, and the will start asking questions like how did it do that, and why did it go black."

b. Teachers should always look at the tools that best work in each situation and for each lesson. Lama mentioned,

> " Most cognitive tools are successful and engaging students if they are at that level. So, in my class of grades 5 and 6, some of them are ready for the philosophic kind of understanding for example revolt and idealism. So, if I present the material in that paradigm, then they are very interested because they want to debate it, but I have other students who show no interest in the subject. So, you have to vary sensitivity to the different types of students in your class. So just because they are in one age does not mean that they are interested in the same way of approaching the material."

c. Roleplay, drama, games, humanization, binary opposites, heroic quality, story, hands-on activities are the most used tools by among the interviewed teachers. Emma said,

> "These helps introduce students to the content and often give me ideas on how to shape the topic with the story form/narrative that is key in IE planning. Role play/games/drama are particularly effective in Science as I want my students to feel like they are really being Scientists, doing what Scientists do, and thinking how Scientists think."

d. What really works is making the teachers involved in the process and engaged in the lesson. Therefore, this feeling will be reflected on students' engagement. Dania mentioned,

> "I find what really ends up working is that basically me being excited about the topic and getting engaged and interested, that is what will draw the students attention and awaken their interest."

Effective Examples of IE From Science Classrooms

I decided to write all the effective examples I heard from the teachers because I found them really interesting. Moreover, I think that including these examples in this report may help other science teachers to share these ideas and implement them in their classes.

*Example 1: Bee, Joke & Metaphor, Grade 2.

A grade 2 teacher named Mia prepared the unit of bee using kinds of understanding and cognitive tools to engage her students and deepen their understanding. From my point of view, the bee unit is a very powerful example as it included many cognitive tools which meet different students' needs. The teacher started with a sense of mystery and asked the students to solve the riddle. Additionally, a very interesting role play was used to stimulate students to look for information. Mia explained,

> "For example, with my grade 2's, I think I will go with my honeybee unit. We did a unit about honeybees and this what had done a workshop on. So, you know several people of IE maybe familiar with this but it was one the most successful units with my grade 2. We started off by creating mystery using riddles I didn't tell them what our unit will be our next unit. We started off with a riddle and then we used through the course of the unit. We used roleplay throughout the course of the unit, each time the students were studying the bees. This made them

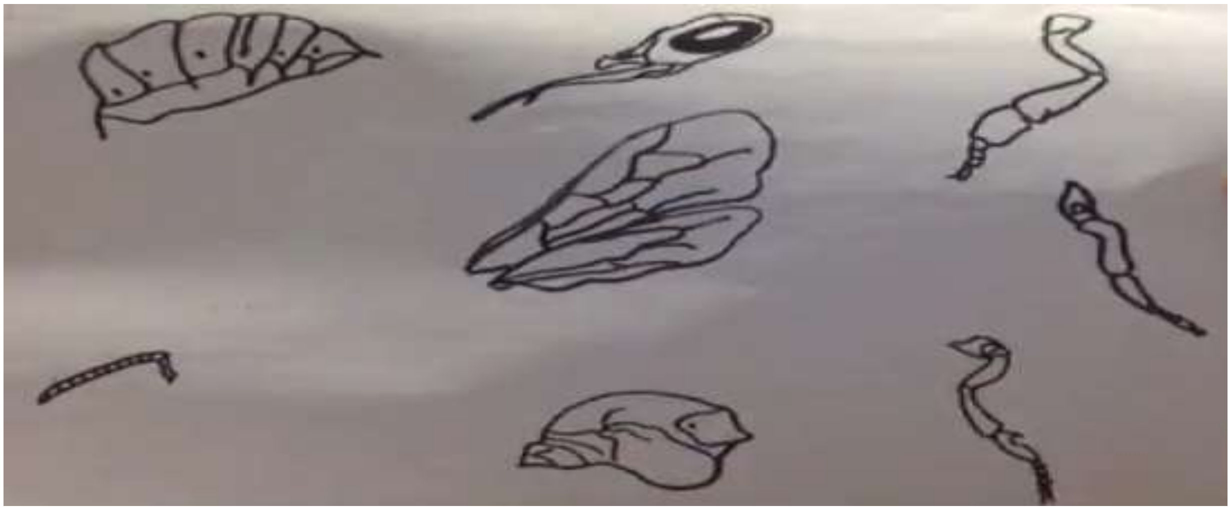
> feel like honey bee scientists and researchers. They used their senses and their observation skills more."

Funny responses were heard from grade two students when jokes and humour cognitive tool was applied. For example,

> "We had the joke of the day. So, you know all bee jokes. So, for example, what goes zub zub? And oh, they said a bee is flowing backwards! And then I would invite them to invent bee jokes and bring more bee jokes in."
>
> "Throughout the unit, students were emotionally connected to bees' life, roles and challenges. Students felt sad because bees die when they sting and a philosophical understanding arose to analyze if the stinger is efficient or inefficient for the bees. While learning about the bee, too many questions arose, and students' interest increases. Therefore, a field trip was made to a honey bee centre to answer some of these questions."

I think Mia consider some of her students to have a philosophic kind of understanding due to their craving for generality. As Egan said, "the philosophic mind focuses on the connections among things, constructing theories, law, ideologies, and metaphysical schemes to tie together the facts available to the students." (1997, p. 121)

> "I give them the parts of bee's body and then they were able to create and put together the way they would imagine a bee's body to be and what I told them they can do is to imagine the most efficient and useful way of designing a bee's body so they got to design a bee's body and then let them be able to explain why this design was useful or efficient."



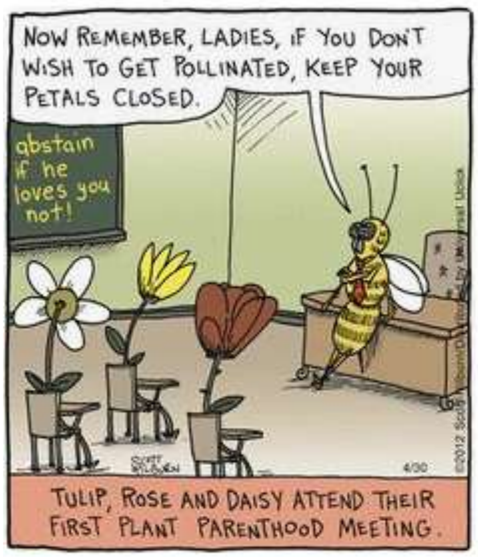
More cognitive tools were applied in the unit; these tools included games and metaphors. For instance, bee hive is like a factory.

> “We used also the metaphor when learning about the bee hive and how the bee hive is set up and organized, we used the metaphor of a factory and how a factory every area has a specific role just like in a bee hive every type of bee or little cell has a role and job for each area of the bee hive.”

Pollination game

> “We did a pollination game where they act out like being a flower or being the bees carrying the pollen to the various flowers. If the same color they end up in the same flower then this flower was pollinated and then it will become a fruit and if not the same color then it is not pollinated.”

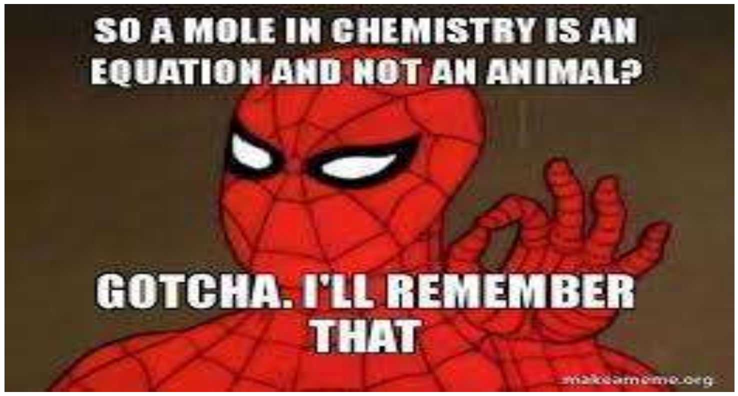
If I would teach honeybees for high school students, I would ask them to create a comic strip. It would triggers students' mind to formulate a scenario that is following a special sequence and going in a definite pattern. In creating the comic strips, students have the freedom to work out a scenario, connecting biology to a real-life story in which they feel themselves part of it. This powerful link between the students and their own story can provoke different kinds of emotion like love, excitement, appreciation, pleasant, curiosity, or wonder.



Other examples from other grade levels will be described in the upcoming parts.

*Example 2: Chemistry, Mole & Spiderman.

For some high school students, chemistry is a difficult subject for them not only because of its scientific jargon and also for the mathematic calculations. It is really exciting to combine different cognitive tools to solve a complicated scientific problem for the students, deepen their understanding of the topic and enhance their memorisation of the scientific facts. As Ava described,



"Mole is like Spiderman everybody hates it but it does really very useful things it saves the world just like Spiderman. So using the hero and the metaphor then using the literate eye so for the calculations which is people usually come up with I used spider web with eight segments the mole in the middle then all the eight calculations around and then the kids really related to that for some reasons and they drew their own little spider working out like mole to mass and the spider would be walking out and back in if there is something from mass to mole and so on and that those tools sort of blended naturally with the mole and it really helped. When I started using that using the cognitive tools to teach the mole, I saw a huge huge difference in the results in term of number of students who are understanding their abilities to do this."

I think a metaphor would be also used to allow students understand the size of the mole (6.022×10^{23}). If 10,000 people started to count Avogadro's number (6.022×10^{23}) and counted at the rate of 100 numbers per minute of the day, it would take over 1 trillion years to count the total number. A roll-mole analogy would be used to explain the calculations.

Roll-Mole Analogy

Given the following information: There are 40 nickels in a roll.
There are 40 quarters in a roll.

Answer these questions. Show Set Up!

(1) What is the value of a roll of nickels?

(2) What is the value of a roll of quarters?

(1') What is the mass of a mole of S?

(2') What is the mass of a mole of Br?

_____ nickels = 1 roll nickels = $_______

_____ quarters = 1 roll quarters = $_______

_____________ atoms S = 1 mole S = ________ g S

_____________ atoms Br = 1 mole Br = ________ g Br

Use only the above equalities to answer the following questions:

(3) How many nickels are in 3 rolls of nickels?

(4) What is the value of 3 rolls of nickels?

(5) How many rolls of quarters is $500?

(6) How many nickels are in $500 of nickels?

(3') How many atoms of S are in 3.00 mol S?

(4') What is the mass of 3.00 mol S?

(5') How many moles are in 53.8 g Br?

(6') How many atoms are in 1.5 g Br?

Answers: (1) $2 (2) $10 (3) 120 (4) $6 (5) 50 (6) 10,000 (1') 32.1 g S (2') 79.9 g Br (3') 1.81×10^{24} atoms S (4') 96.3 g S (5') 0.673 mol Br (6') 1.1×10^{22} atom Br

*Example 3: Periodic table, Heroic quality, Grade 6.

For students, studying the elements of the periodic table can be boring, and they consider many far away from their real lives. The following example which contains humanization and a heroic quality bring to life each element of the periodic table. Allowing students to choose their element then search and find a hero then write a narrative created a positive learning environment and enhance students' imagination. Dania explained,

"Last term, I taught a grade 7 unit on the periodic table. What I did, I had students to create basically a tool about every element in the periodic table has her own personality. So, humanizing the meaning having students then choose an element to do a research about it and then decide if it is a super hero or super villain base on the characteristics of that element and I found kids got really excited because here is the idea of hero quality but the students chose the element instead of me telling them so for example when kids show arsenic and they decided to create the super villain and who want to kill people to do a research about the element and then to use their imagination to create hero quality and narrative based on their research and I found them really engaged and I still have students from last year who come to me and tell me about the hero quality and the super hero in the story."

Another interesting cognitive tool that engages grades 6 or 7 students is rhyme and rhythm. My students enjoyed listening to the periodic table song. They became familiar with the names of the groups like halogens, noble gases and alkali and they got an idea about where to find each element in real-life. Here is the link to the website https://www.youtube.com/watch?v=rz4Dd1I_fX0

*Example 4: Chris Hadfield, fantasy, Grade 2.

Teaching abstract concepts for students and especially elementary students is a challenge. Students are making sense of the world in primarily mythic and romantic terms. Leen mentioned,

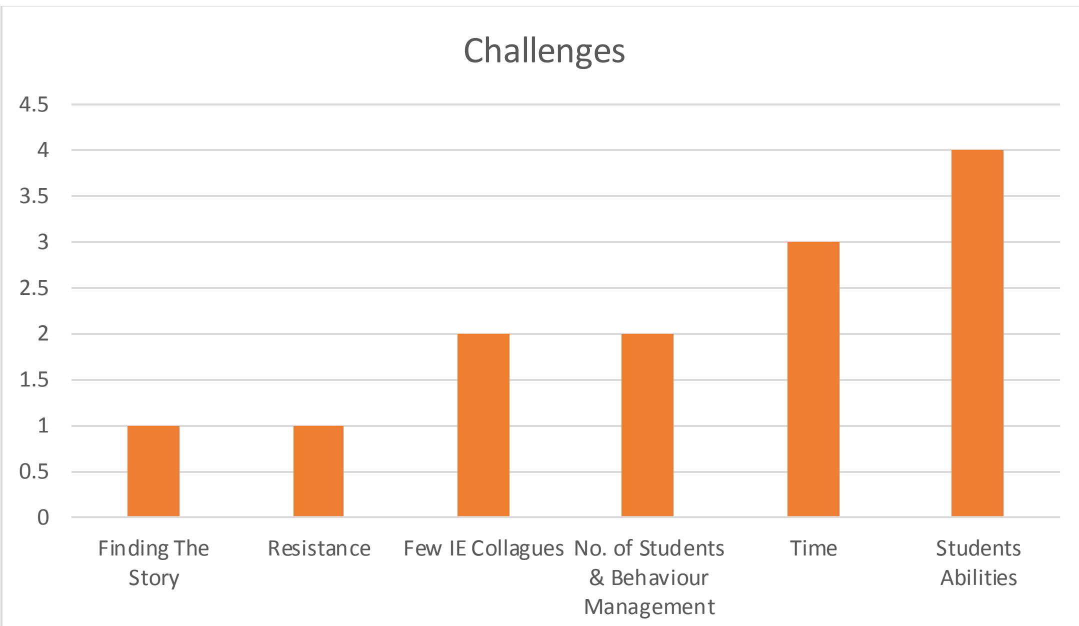
> "I was thinking of using story they really found it interesting when they found out about Chris Hadfield who was the Canadian astronaut and he inclosed videos about his life on the space station and they were into role somebody was in there. So, all of the daily life that happened in a space station were really exciting with that. And then we did a unit on mapping and at the end of it, they have to do using their mapping skills to figure out the scavenger hunt so that really engaged them with a challenge and a game and they got use what they have learned."

As Egan mentioned, "a distinguishing feature of myth stories is their fantasy, their dislocation from the everyday rules of the waking world we live in." (1997, p. 44)

I would assign an imaginative activity to grades 7or 8 students to explain organisms, space, motion, and gravity. For example, the title of the activity would be "Aliens Needed!!!!" The instructions would be as follow: The Bio Room movies is about to produce a new animated movie about life found in a distant galaxy. In this feature we need to create a world of organisms never encountered on Earth. It is our hopes to form an on-going series about this new world, so we need detailed information about these new organisms, environment, gravity and motion.

What Are Some Challenges?

The challenges varied according to every teacher's experience and condition. However, some of the most common challenges that the participants faced included:



1. One teacher struggled to find the story that would stimulate the students' curiosity and attract them to the topic. Isabella wrote,

> "What I find most challenging, is that I cannot always find the story that evokes emotion. This is something I need more practice with."

According to me, I didn't face this problem because the content of science would be taught in story-form.

2. Another teacher discussed the problem of the opposition. Ava said,

> "But the worst situation would be if you are alone and doing it and other teachers or the school administration is actively resisting it and actively saying it does not work."

> "If I have an objection from the students who would say just teach me the stuff I need to know for the test."

Having students who are refusing to accept this new approach in class or dealing with colleagues who are criticizing you and your methodology is like being a car that is stuck in the snow. A teacher whose primary role is to widen students' thinking and improve their academic level is struggling to achieve his or her goal in this case.

To solve this problem, I think, I should insist on my opinion and at the same time work hard to show my students, colleagues and administration the good results of my new strategy. Therefore, I can prove that what I am doing is right. From my perspective, the only way to convince others is students' achievements.

3. Two teachers talked about the problem of being the only teachers in their schools using this framework. Mia explained,

> "Not having colleagues on staff with whom I can collaborate and share ideas because we know that they are not necessarily thinking along with cognitive tools or imaginative practice makes it very difficult to efficiently perform and do the work that you are supposed to do.."

Other teachers may look at the IE science classes and claim that the students are playing and they are not studying. Alternatively, they might understand that this is a new methodology, but there is no one in the school to share IE teachers' thoughts and challenges.

In my opinion, inviting other teachers in the school to observe IE classes would provide a great opportunity to other teachers to see IE in practice and sharing with them IE lesson plans would help in spreading the new IE approach.

4. Two teachers stressed on having overcrowded classrooms which can lead to misbehaviour problems among the students.

Dania spoke,

> "I guess behavior management is one obstacle that teachers usually face. So how to get 27 students with different reading levels all of them focusing on the same thing but as well, I can feel in the room when students are engaged less behavior and when they are bored that is when I find kids are acting more, they are not listening, and they are bothering their friends."

And Ava added,

> I think that this does not really work if you have too many students. I found that the ideal number of students is 20 to 25. It works well with fewer students, but it does not lead to as rich environment when you have fewer than 20 students and more than 30 students it is way too much, and 30 is really a stretch.

According to Muthusamy (2015), overcrowded classrooms will influence directly on the students' behaviour and achievements as well as on teachers' performance. Having many students in the class will make teachers stressed and overloaded. In addition, engaging students in the lesson and building a strong emotional connection with students would be almost impossible. On the other hand, students may suffer from insufficient spaces in the classrooms and health problems. Therefore, IE implementation in crowded classes would be almost impossible.

5. Three teachers believed that time is a big challenge. Teachers are confused between curriculum and deep learning. Leen said,

> "I think some of the challenges is timewise to be able to cover everything you are supposed to. And then, really take time to really engage them, or we want to rush through and say we have to cover this. Then, you do not give them time to actually understand it and engage in it. And just balancing how far in depth and how much you want to cover between the two of them. And I think mostly I try to think of what are the most important ideas and try it to have students learn about certain topics and then focus on those and then as with time maybe I am not going in depth, but if they really understand something really well then, I focus on that rather than trying to cover as much as possible in the little time that we may have."

Furthermore, teachers commented on how time consuming it is to prepare IE lessons especially with the overload work that most teachers have at home and school.

On the other hand, when asking other teachers whether the time is a challenge, they answered that time is a challenge for all teachers not only IE teachers. In addition, when asked about balancing between curriculum and IE activities, Ava pointed,

> “No, I disagree with that, and the reason that I disagree with is that, if I am doing something that is ineffective, I will do it, again and again, to make sure that this kid understands it. Then all the students will say that they understand it. So, I will be spending more time with an inefficient teaching method that does not work. If I match the cognitive tool with the topic, then I cut the time in half the time that they need to understand the concept.”

Another teacher said that time is not just a problem for IE teachers; it is a problem for all teachers. Seeking time to prepare lessons, check students’ work, attend classes and fulfil all other tasks are common for all teachers. Therefore, teachers should go through their priorities and manage time wisely.

One of my biggest challenges in implementing IE in my science classes was time. As a high school science and biology teacher, I had to do many standardized tests and I should prepared my students to have good scores. Checking assignments and solving many worksheets for practice in the class took a lot of time. Therefore, I ended up with choosing IE activities that would be covered in a short period of time. In a class of 60 minutes, the maximum time that I can keep for an activity would be 10 to 15 minutes only. I think it is not enough to do a role play, create a song or tell a fantasy story. Sometimes, I extended the activity to two or three classes in order to complete it. As I mentioned in the personal location previously, I had only two science classes per week for every class. During the

120 minutes per week, I should explain, check assignments, solve worksheets, do quizzes or tests, and do activities.

6. Four teachers emphasized on the big problem of having students with different abilities in one class. In this case, it would be very difficult for the teacher to reach every student's level and kind of understanding. Moreover, it needs a lot of time and effort to have an effective IE implementation. Lama described,

> "The different levels of ability. So, grade 5 and 6, because it is an inclusive classroom not a special need classroom but inclusive which means everybody is welcome to come and participate in the learning process, but it is not good specifically to children with challenges even though we modify and accommodate. So, I have a student who reads as a grade 2 level, and I have a student who probably reads as a grade 7 level. I have a student who can build a 3 D complicated structure, and I have a student who does not have any kind of these skills. In one classroom, there is such wide variety of students to an extent for all the students to be catered for, you might have to do multiple lessons so that the students can understand that one topic and that is very time consuming. "

Gifted and talented students get bored easily; therefore, they might start chatting and disturbing their classmates. At the same time, low achieving students may experience excessive daydreaming or feel pressured to do more. Teaching a mixed ability class makes the teachers very stressed. If teachers are unaware of this huge problem, it can create a negative working environment that will ultimately affect the learning process.

How to Overcome These Obstacles

When reading and comparing the answers of the seven participants, I found different solutions to a different set of problems. In the table below, I will address the problem and the possible solutions:

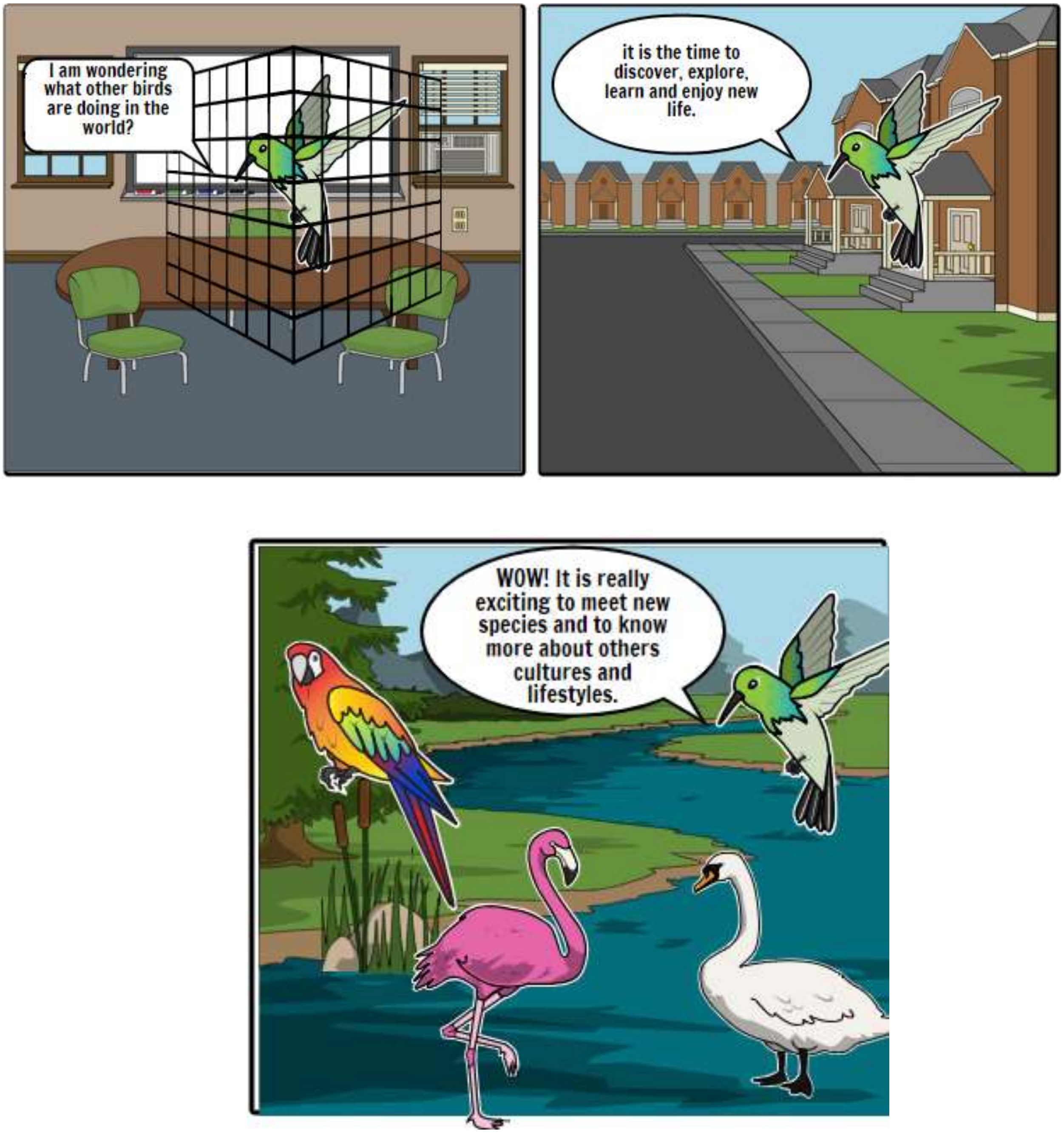
Problem	Solution
1- Find a story	Isabella wrote, “I recently heard an IE educator say that they like to find poems about their topic to help them find an emotional connection to the topic. I have started to do more of this in my more recent planning. It turns out there is poetry on almost any topic you can think of!”
2- Resistance	The teacher should convince students especially in high school about the new strategy used and its great impact on their academic level as well as persuade the parents about it. Ava mentioned, “If I have an objection from the students who would say just teach me the stuff I need to know for the test, I would convince them to have a have little more patience. Teachers should be patient and never give up when implementing new ways that can help students to improve and succeed in school. Mia said, “I think one big thing is persistence. I should make sure that I do not give up.”
3- Few IE colleagues	A regular meeting among IE teachers would be very beneficial to share ideas and lesson plans. In addition, they can discuss some spontaneous problems arising in their classes and suggest some solutions.

	Mia explained, "I really try to reach out to others in CIRCE and also others who have IE background, so I can share ideas and talk through things. And really keep up to date with any resources that are out there that talk about imaginative practices not necessarily cognitive tools but also imaginative practice on a larger scale."
4- Behaviour management	Dania recommended making the lessons more interesting even if this will take more time in lesson preparation because this will lead to better management. Giving students a specific role in the learning process would help in class management, too. Ava proposed, "If there is one kid who already knows it I would recruit that kid as a helper and ensure that they have a role to play."
5- Time	Emma wrote, "Simply prioritizing what is most important and learning to say no to new initiatives/programs that will take time away from what we are already trying to accomplish in our classroom. This is something that is very difficult to do." Lama said, "About time consuming, I look at graphic organizers that other teachers put together." Leen believed, "I think it is just more trying to balance between how far in depth you will cover something and how content you will cover. If they haven't learnt 25 facts about a science topic and we had covered only 10 of them or something but they really understand and grasp, and they can talk about

	then I am trying to focus more on that rather than how much they know or how many facts they can tell and more they can actually discuss it.”
6- Students Abilities	Lama divides students according to their abilities and put students with similar abilities in one group. Isabella, Lama and Leen suggested that teachers must include Different activity levels to meet all students’ need. Leen said, “there are a few people who do engage so I try to think of something that would engage in different things.”

I think to overcome many of the problems mentioned by IE teachers is to communicate with other IE teachers and experts. They would find practical solutions to the problems such as finding the story, sharing ideas about behavioral problems, or how to deal with different students abilities. In addition, I would suggest that teachers reflect on each lesson or unit by writing “YIKES”, “WOW” and “CHANGES” in a journal or iPad. In this way, teachers can be more conscious about the weaknesses and strengths in each lesson or unit and try to improve it next time. If the problem is about time management, the teacher would use an alarm in the class to fix a time for each task. Teachers must keep on reflecting on their work to keep their progression.

VIII-Personal Reflections and Discussion



My previous action research project was about creating comic strips in biology classes. My purpose was to find out if creating comic strips can deepen students understanding and if my students will take part in completing this activity. Because I was engaged in creating comic strips and I wanted to include an art piece in my project. I decided to create these three panels comic strips. I was very much similar to the caged bird when coming up with the art project. I was deeply engrossed in my classroom implementing my old traditional ways of teaching. After thinking outside the box, I decided to update my teaching methodologies and looked at other ways and teaching styles. In the third panel, you can see my critical friends (Mary, Brenda, Joshua, and me). These three friends were very cooperative, and their help is not limited to this action research project. They are also still giving me social lessons, cultural lessons 😊 and I really appreciate their good advices with regards to my resettlement here in Canada , getting a job and this action research project. During our conversations, we shared many ideas, therefore, they helped me in generating new ideas and in enriching my project. For instance, I was confused what to write in the research site and they told me what I should include. It was Brenda's idea to write about what IE and new BC curriculum shares together, and to use Maxwell quotes to prove the validity of the research.

What Could Be The Fourth Panel?

If I created a fourth panel, I would draw more and more people representing my other colleagues, professors and supervisor. I would talk about how each one of them helped me and is still helping me, and how my new life is full of challenges but I am still pressing on.

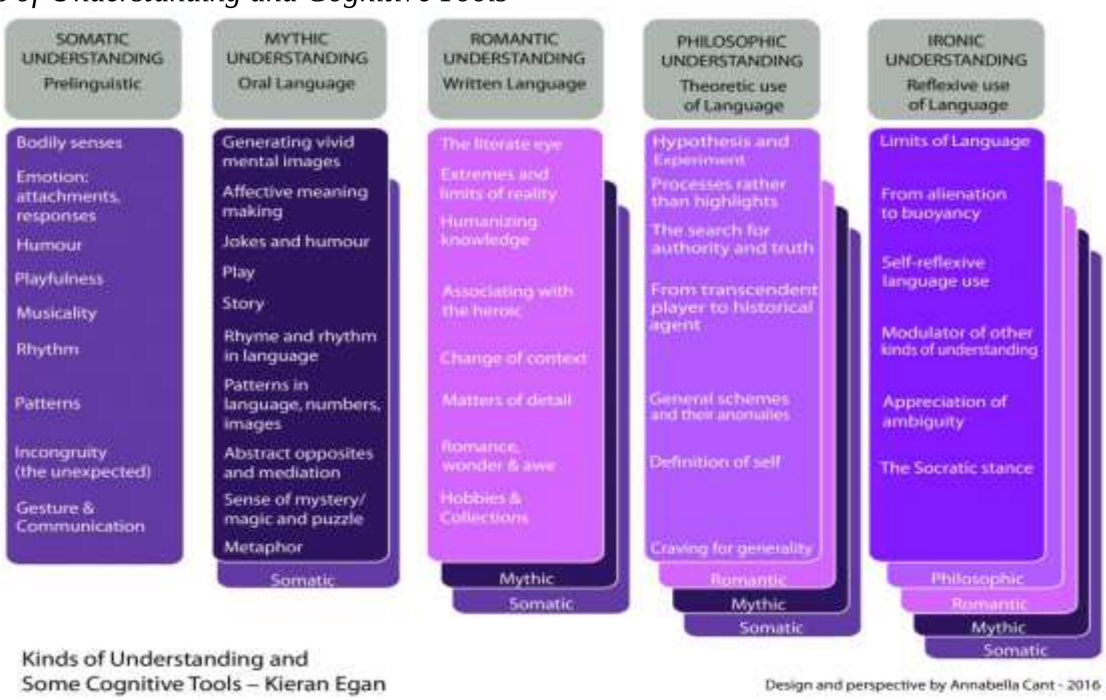
In this fourth panel, I am looking forward to finding a job and apply more IE activities in science classes.

Why IE?

Several years ago, I was in Lebanon seeking to join a Masters degree in one of their local universities, but all my applications were rejected. My big break came a few years later when I was invited to take a Masters degree in Canada. I could not believe it. For me this was a dream come true. I have always dreamt of pursuing my studies in Canada. As excited as I was, one thing deeply worried me; there was a condition for my admission to the program- I had to maintain a B+ GPA. And so, I worked really hard and got the grades that I needed, and later I got my student visa. My dream was finally coming true. In my first visit to the SFU campus in Surrey, I looked all around and say to myself "Thank God, it was just a dream and now it is the reality".

Since a majority of the teachers said that they wanted to apply new strategies in their classes and were interested in the imagination concept of this program, I looked at making a real change in my teaching methodologies and particularly in updating it in order to meet the needs of my students.

Types of Understanding and Cognitive Tools



As a human grows, he or she passes through different kinds of understanding and during each kind different cognitive tools can be used to make meanings and to emotionally connected to what we are learning. I liked how every teacher explained to them using their own words and ways and found the flower metaphor very interesting in describing the four kinds of understanding.

Lesson Plan

Most teachers said they would start with a story and this is what makes IE different from other approaches. IE is based on storytelling to connect students' emotionally with the topic and engage students in the classroom by applying the right tools.

Last year, I did not have the chance to prepare all the lessons using IE approaches. However, I planned two lessons one about "DNA" and one about "the immune system". Although I found it a little bit difficult to find the story when it comes to scientific topics, it became easier when I discovered that the content itself would be the story. The story for the immune system would be "the battle started when the viruses multiplied very fast inside the body turning the cells into a virus factory. In order to slow down, then to stop the viruses from reproducing, some key defense systems act like an army. Let's see how this defense systems work together to return our body to function properly. Ahhh! My skin which is the first line of defense couldn't protect me from this virus because it found a way to enter through the opening of the nose or mouth and reached my throat. Now, the virus is inside my body causing too much harm and Ughhhh, I don't feel too good. I really need some help. Help! Help! Hello!......."

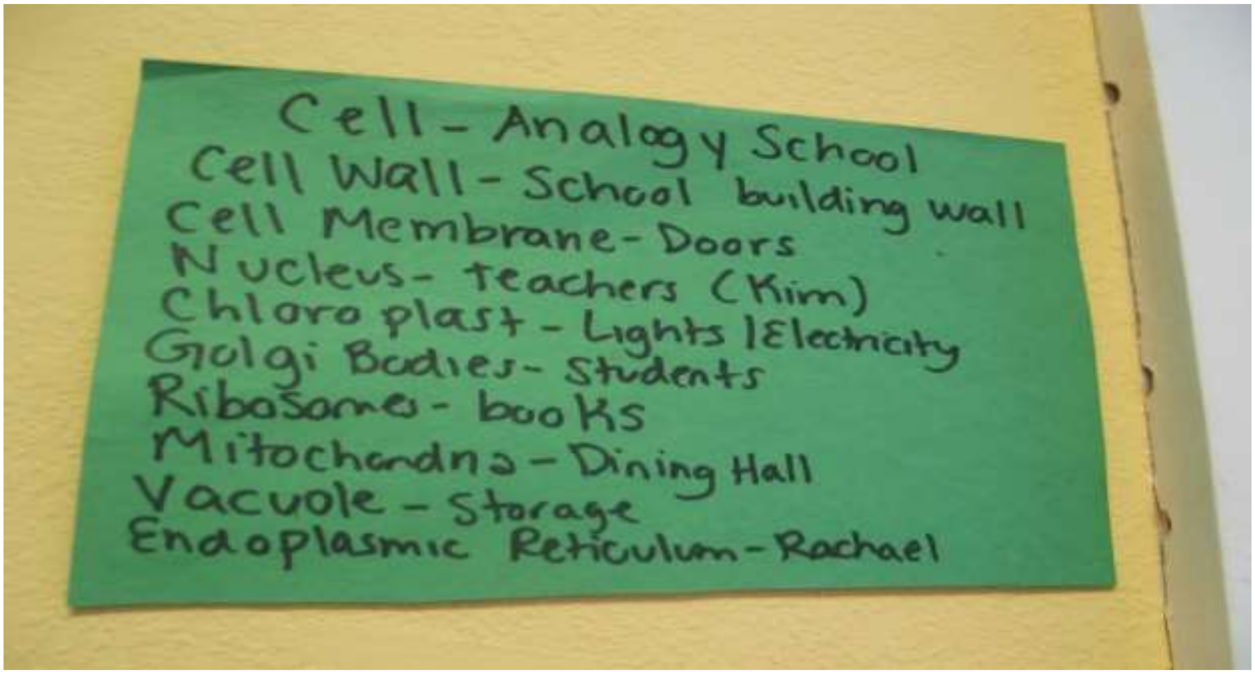
After finding the story, I have a look at the content of the lesson and try to figure out what cognitive tools can be used for this particular topic. Additionally, for high school students, I give them the chance to choose among different activities representing different cognitive tools. For example, for DNA replication, three options were given. First, students could create a song. Second, they could make a model. Third, they could come up with a metaphor. Students were motivated and more excited to learn and participate.

What Works?

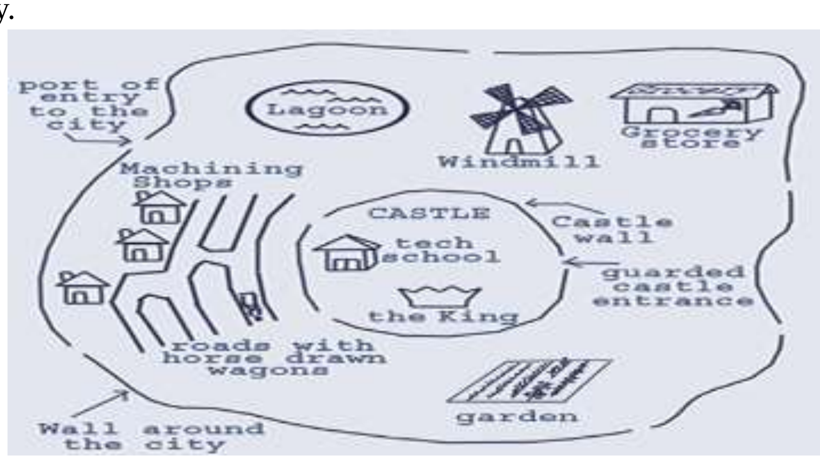
I totally agree with the teachers who said that what works in science classes will depend on the type of lessons, students' interests, and being smart in choosing the right cognitive tools. Moreover, most of the participants said role play, rhyme, metaphor, jokes, and all cognitive tools could be implemented in science, and this is true. However, I found that the most used ones for IE teachers or other teachers are a literate eye, metaphor and using the five senses. In almost every science lesson, there should be a table, concept map, or Venn diagram to show the relationship between the scientific facts or vocabularies. Furthermore, lab experiments (somatic kind of understanding) are very efficient ways of teaching. This could be a real application of a solid scientific theory. Finding the metaphor is very effective in making this comparison between what is known and unknown for students.

Effective Examples from IE Science Classes

I am curious to hear other teachers' examples, gather more information and try to practice them in my classes. The effective examples that the participants mentioned were really interesting and showed a lot of creativity on the teachers' part.



For a majority of students, learning about the cell organelles and their functions is extremely difficult. Explaining the analogy between the school and the cell usually makes it much easier for the students to understand and it also facilitates the memorization of each organelle function. Later on, as an activity or a project, students should find their own metaphor and find the connections between their examples and the real function of cell organelles. Different examples were given by students as a factory, stadium, or restaurant. Here, in the picture below, is a comparison of a cell to a medieval city.



What Are Some the Challenges?

I had already mentioned some of my challenges in the personal location. I will summarize them in the bulletin points below.

- I am covering the curriculum provided by the academic advisor.
- I am managing the two hours of science per week between activities, tests, midterm, revision hours, and finals.
- I am taking permission from the principal for any outside activity (long procedure).
- I am engaging all middle and high school students in all activities (some like rhyme and rhythm, others admire drawing, others like reading, others prefer role play, etc).
- I am reaching out to IE colleagues to discuss challenges, find solutions and share ideas.

After hearing and reading the participants' challenges, I found that we faced similar obstacles. However, I had a more rigid educational program than what they had.

So, the resistance that one teacher talked about occurred when some of the students refused to complete some activities and said, "it does not make sense, and I want only to practice for the test". On the other hand, the resistance was also from the school administration. If I want to take my students outside to collect leaves, play game or explain a lesson, I should take the head of section or coordinator's permission. Cameras are found everywhere and anywhere in the school to watch all students and teachers' behaviors and commenting directly on them such as "why these two students are sitting far away from you? Keep them nearby." As teachers, we should always be awake and not only teach students but we should supervise them very well. In addition, taking the girls students to any exhibition outside the school was a very complicated process because the administration should inform the ministry about it ahead of time and the principle herself should take precautions for the safety of the girls. For example, the place should be reserved for ladies only during our presence, girls shouldn't open the window of the buses, at least there should be one teacher for every five students, buses are not allowed to stop on any coffee shop, restaurant or hypermarket, etc. If I want to ask for a field trip with all these rules, I would be stressed thinking about it because of all the strict rules and the responsibilities that I would hold. By the way, not all schools have the same strict rules. I taught before in an international school and it was more flexible. Another major problem was lab materials. Starting with a somatic kind of understanding using a lab experiment can stimulate students' thinking and the sense of wonder may arise. unfortunately, I made more than four times orders for lab materials and I didn't get them.

I totally agree with both teachers who said that it is a real challenge to have a few IE colleagues. I lived this experience, and I did not have any IE teacher in the whole city to cooperate with her or him. I felt overloaded with the preparation and lonely in the applications. However, I was lucky to have a partner teaching parallel classes in grade 8. She did not have any idea about IE but she was a good listener, and she tried out many of my IE activities in her classroom, and she gave me very effective reflections regarding students interactions with these IE activities.

Many teachers said time is an issue and I think this is a common problem for all teachers. Balancing between IE and curriculum is still manageable for most teachers as they said especially with the implementation of the new BC curriculum which is more flexible than the previous curriculum. However, in my case with a lot of quizzes, tests, and exams and two hours per week could not have time to implement a lot of IE approaches.

Having students with different abilities and interests in one class is one main challenge. So, preparing an IE activity would be really engaging for some students but boring for others because it is beyond their level of thinking either much higher or lower. I think that it is almost impossible for one IE activity to have 100% engagement for all the students.

How to Overcome These Obstacles?

In case I go back to teach in Saudi Arabia, I cannot change the school system. The science periods are fixed, and the testing system is continuous. In addition, I cannot ask the administration to put students of the same levels in one class. What I would do could be balancing as much as I can between the curriculum and the IE approaches. Furthermore, I would prepare many class activities using different cognitive tools to meet the needs of the students. I would recommend the publication of many IE science plans; therefore, the implementation would be much easier. I might directly use its content or edit it, but still, it can save time to start from a base rather than starting from scratch.

Administration

While I was conducting my interviews, an additional question arose. I asked my participants the following questions "did you have any problem with the administration with regards to IE implementation?" and all of them said that their school administrations were very supportive. Mia said, "With learning in depth, they spoke to my staff about what I had been doing in learning in depth and sharing with my staff as well, so I had full support."

I think that when the administration supports the teachers and appreciate their work, this will encourage the teachers to be more productive and to feel more engaged at work. I was curious to know how administrations deal with teachers. I discovered that Canadian teachers have more freedom than I expected. Through my twelve years of experience in four different schools in Saudi Arabia, teachers were supposed to follow the hierarchical organization of administration. For example, before photocopying any papers, the coordinators had to check the content, its format and sign them. When sending a notice to the parents, the coordinators had to approve it before sending the notices were sent. All lesson plans had to be discussed with the coordinators for me to be granted any approval. Permission from the head of the section had to be obtained before any outdoor activity or a field trip. However, not all head of sections, coordinators or principles are so strict. Some could be more flexible and give a little bit of freedom to the teachers.

IX-Suggestions

Having a community

Ava described, “So, for instance, if you have only one in your school try to have a community outside of that. Let us say a ***coffee group*** you meet once in a month with other IE teachers so then you share what works and what does not work. Having somebody to talk in a community can be very helpful.”

Step by Step

Dania commented, “It took me a longtime when I was in the program to understand what it really meant to be an IE teacher. It is not so about the planning that you do, but about the whole teaching process.”

Sharing ideas and lesson plans

Leen suggested, “we can create something, for instance, an IE website lesson plans and ideas can be shared.”

Inviting people to know more about IE

Mia said, “the work that Gillian is doing with CIRCE is wonderful. I mean the website, the blog. I think that this will be of a great and tremendous source of information for new IE teachers practising and other IE teachers. I think we need more face to face contact. Organizing events or conferences will bring imaginative practitioner or people who are not familiar with it but who have an interest in it so that they can learn more and share ideas.’

In the next part, I will comment on these suggestions and I would propose some effective ways to make IE implementation easier.

Personal Reflection on Suggestions

It was a wonderful gathering. We had the chance to meet new IE teachers from all over the world. I believe that such kinds of gathering are very crucial to building a connection between IE teachers all over the world and meetings like this makes it easy for teachers to share and come up with new ideas.

I totally agree with all the suggestions put forward by the teachers. However, I want to stress something that I personally find it very important. Most teachers seek a direct implementation of the theory. Even if they attend workshops, they look at what they can apply in their classes the next day. So, I suggested having a lot of lesson plans prepared. These lessons plans could be published online, and I think it is preferable that these lesson plans are shared at no costs or for a very small fee so that any teacher can access them. In the CIRCE, there are three science units published right now. I think if I will find the topics that I will be teaching, I would really benefit if not 100% but maybe 50%. Even if I wouldn't be able to implement the whole lesson plan, I would some ideas to share and implement.

Additionally, a WhatsApp group can be a very useful way of communicating with other IE teachers or experts, to share ideas, events, lesson plans, or discuss other challenges and give some suggestions.

X-Limitations

Having five recorded interviews and two written interviews allowed me to build up my report and have rich data to interpret the results. Six of my participants were elementary schools, and only one was a high school teacher. I thank all those who helped in gathering data, and I appreciate everyone who participated in the research. What I consider as a limitation in the project is the limited number of high school science teachers who were involved. I expect that high school teachers would talk only about science and go deeply through science lessons, labs, and curriculum, because they are subject teachers and all their experience, is about science whereas elementary teachers teach all subjects and this was somewhere obvious in some of their answers. For example, when one of them was asked for an effective example of IE from a science classroom, she explained her experience in a math class then she added another one for science.

XI-Observation and What Next

Before my arrival to Canada and while studying my online IE certificate, I thought that imaginative education is the main methodology used in Canada. Later on, I discovered that this is a new framework and that not all teachers are familiar with it. And, I believe that our role as IE teachers is to spread IE thoughts among other teachers.

Tuesday, February 26, 2019, was my first day in North Surrey school as a volunteer practicum student. I have a schedule from Monday to Thursday, and I am helping in checking tests, lab reports, photocopying papers and answering some students' questions. I am very glad to have the opportunity to observe how Canadian schools are and look at the type of strategies that teachers use.

About my practicum, I am really astounded by the behaviour of the students, administration rules, and roles of the teachers.

- Students

-They have mobiles, but they are using them wisely.

-They have the chance to run away from school because all doors are open, but they are still sitting in their classrooms.

-They can talk, but they do not shout.

-They can eat, they can do their homework or project in class, and most of them are listening to teachers' explanations.

- Administration

-The administration gives students and teachers freedom which I think it is fundamental to allow students and teachers to innovate in their work. And what caught my eyes that both teachers and students are respecting this freedom.

-Parallel teachers have the choice of using the same activities in all common classes or not. It is giving the teacher the right to choose what is better to her or his class without being obliged to copy another teacher's work.

- Teachers

-Even if they do not know about IE, but they are still using cognitive tools such as literate eye, metaphor, and games. I am observing different grade levels (grades 8, 11, and 12) and I am helping five science teachers.

-They are really hard workers. I usually complained to teach five hours a day, and they have a full day teaching! They have four blocks per day.

-They have a lot of preparations but still interesting that students are cooperative and good listeners.

Further research would be done to set up an evaluation and assessment framework that can be used in IE science classes.

XII-Conclusion

This research project was designed to have deep ideas about IE insights and challenges from science teachers' point of view. Furthermore, I pointed out some ways to overcome the obstacles and summarized teachers' suggestions for a better IE implementation. I tried throughout the project to show the comparison between my own experience and others' experiences. IE approach is engaging students and provides new teaching ways to stimulate students' imagination in learning. I consider myself a lucky teacher to implement this new methodology in science classes to evoke wonder, connect students' emotions with the scientific topics and deepen students' understanding in science. It was a great opportunity for me to conduct this action research which to understand Canadian teaching styles and its educational practices. I hope to teach in Canadian schools to have a new kind of experience and have the chance to reflect more on IE implementation in science classes.

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