Final Assignments for IB 677 and IB 675
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A look at the top 46 pharmaceutical that changed our world and have a major impact on health and society 11th and 12th grades.

To add a genuinely generative spin on the chemistry classes, students were engaged in critical analysis of science-related real world context papers as a way of developing students' understanding of standard-based scientific inquiry. This provided the opportunity for understanding the integration of the interdisciplinary concepts, as well as reinforcing the IB leaner profile (inquirers, knowledgeable, thinkers, communicators, principled, open-minded, caring, risk-takers, balanced and reflective). In addition, such insight will allow the implementation of the knowledge, concepts and skills of a curriculum for Global Citizenship. During this classroom activities, I was able to apply several principles for leaning in a social context: 1- teacher and students work together on a specific, 2- managing dialogue toward a specific goal is at the heart of an effective classroom, 3- providing meaningful tasks for students accelerate learning, 4- teach complex thinking stimulates critical thinking and 5- developing competence in the language of instruction across the curriculum.

A- Inquiry

Inquiry based learning is searching for knowledge through questioning

The way chemistry is being taught in high school is very dry except for some laboratory exercises and experiments that have little effect on the development of understanding, ability for inquiry and knowledge of science content. The results are usually similar for all the students and thoughtful public communication of students' ideas and work with classmate is not part of the results. Giving the students the opportunity to learn subject matter disciplines in the context of inquiry and interdisciplinary was a rewarding scientific experience to both students and myself.

The National Science Education Standards envision change throughout the system. The science content standards encompass changes in emphases (Table 1) as well as emphases to promote inquiry (Table 2) (Science Content Standard, p. 113). It is clear that there should be changes of emphasis to promote inquiry and interdisciplinary in science education. Parts of the emphasis in teaching science should be directed toward understanding scientific concepts and developing abilities of inquiry as well as integrating all aspects of science contexts. Few fundamental scientific concepts should be studied at first. This will help to implement inquiry as instructional strategies. In addition, activities should be carried out to investigate and analyze science questions over extended period of time. Doing more investigation should be encouraged in order to develop understanding and knowledge of science content. Assignments should encourage management of ideas and information. Also, students should be encouraged to communicate their ideas and work with their classmates.

Table 1: Changing Emphases **(**Science Content Standard, p. 113**).**

LESS EMPHASIS ON	**MORE EMPHASIS ON**
Knowing scientific facts and information	Understanding scientific concepts and developing abilities of inquiry
Studying subject matter disciplines (physical, life, earth sciences) for their own sake	Learning subject matter disciplines in the context of inquiry, technology, science in personal and social perspective, and history and nature of science
Separating science knowledge and science process	Integrating all aspects of science content
Covering many science topics	Studying a few fundamental science concepts
Implementing inquiry as a set of processes	Implementing inquiry as instructional

	strategies, abilities, and ideas to be learned

Table 2: Changing Emphases to Promote Inquiry (Science Content Standard, p. 113)**.**

LESS EMPHASIS ON	**MORE EMPHASIS ON**
Activities that demonstrate and verify science content	Activities that investigate and analyze science questions
Investigation confined to one class period	Investigations over extended periods of time
Process skills out of context	Process skills in context
Emphasis on individual process skills such as observation or inference	Using multiple process skills-manipulation, cognitive, procedural
Getting an answer	Using evidence and strategies for developing or revising an explanation
Science as exploration and experiment	Science as argument and explanation
Providing answers to questions about science content	Communicating, science explanations
Individuals and groups of students analyzing and synthesizing data without defending a conclusion	Groups of students often analyzing and synthesizing data after defending conclusions
Doing few investigations in order to leave time to cover large amounts of content	Doing more investigations in order to develop understanding, ability, values of inquiry and knowledge of science content
Concluding inquires with the result of the experiment	Applying the results of experiments to scientific arguments and explanations
Management of materials and equipment	Management of ideas and information
Private communication of student ideas and conclusions to teacher	Public communication of student ideas and work to classmates

Furthermore, science curricula need to be challenging for the students, and based on the "real world" of student interactions with nature. The National Science Education Standards and the Project 2016 Benchmarks, together with state and local frameworks, present a consensus on which to build such curricula. The 2002 NRC report on improving advanced study of mathematics and science in U.S. high schools, stresses that inquiry-based learning and laboratory experiences are essential components of chemistry and science instruction at all levels. To help meet standards of excellence, educational organizations support:

1- Developing science courses based on inquiry based learning, as defined in the National Science Education Standards, and evaluating performance using standards based assessment techniques. Classroom evaluation should assess higher-level cognitive skills, including the ability to apply science knowledge in new situations.

2- Redesigning chemistry courses to present a broad view of the scope of modern chemistry by including topics such as organic, polymer, biochemistry, and materials science.

3- Integrating science content across disciplines and throughout the years of the secondary school experience.

4- Enhancing articulation between high schools and two-year colleges.

The International Baccalaureate Programs and events allow the students to grow in many ways, intellectually and socially. The academic rigor of the IB is important, but its humanitarian values are everything. IB founders believe that through high-quality

education, educators can create a better world. No students are excluded, no matter what their backgrounds might be. (IBO Council of Foundation, 2007d, IBCC, 2008)

IB programs promote the education of the whole person, emphasizing intellectual, personal, emotional, and social growth through all domains of knowledge. IB program characteristics are:

1- international
2- Develops critical thinking skills
3- 2nd language required
4- Study across a broad range of subjects, include both individual subjects and trans-disciplinary areas
5- Provide collaborative planning and research
6- Encourage students to become more responsible members of their communities.
7- Emphasizes cultural understanding
8- Programs shaped around creating a better world

All aimed to develop students who can create a better world through intercultural understanding and respect. (Hill, 2008, IBO Council of Foundation, 2005, 2006a, 2006b, 2007c, 2007e)

At the heart of the IB is the learner profile, a long-term, holistic vision of education for the 21at century. It describes 10 attributes of international mindedness whereby IB learners are inquirers, knowledgeable, thinkers, communicators, principled, open-minded, risk-takers, balanced, caring, and reflective. (IBO Council of Foundation, 2005, 2006a, 2006b, 2007c)

IB students are exploring, synthesizing, theorizing, and learning how to learn. Done right it seems to be a model for all who want the next generation to be as prepared for modern world as possible. (IBO Council of Foundation, 2005, 2006a, 2006b, 2007c) Efforts to alter the course of university preparation led to three great IB innovations that distinguish it today from other college level programs, such as AP. Each of the ideas grew from the IB founders' notion of what an educated person ought to be and became a parts of the program that students praise most often- the extended essay, the creative, aesthetic, or social service activity (CASS) and the Theory of Knowledge course (TOK). (IBO Council of Foundation, 2007c; Alchin, 2008, Jones, 2008)

The extended essay had many influences. High school students need and intellectual outlet for "grand passion". That led to the requirement that every candidate for the IB diploma conduct a significant piece of research on a topic of his or her own choice. The idea was to develop research skills and encourage the kind of critical thinking learned in Theory of Knowledge. The extended essay had to apply to one of the six IB subject areas and be about 4,000 words in length-the equivalent of about sixteen, double spaced pages. It had to be done over four to six months of the candidate's own time under the guidance of a teacher, and be graded by an outside examiner. (IBO Council of Foundation, 2007, 2008, Mathews, 2005)

The extended essay in the DP is another in-depth inquiry intended to promote high-level research and writing skills, intellectual discovery and creativity of a topic of the student's own choice and prepare them for higher education.

Those assessments allow the students to grow personally and socially, developing personal skills and make connection with academic studies and real life. Therefore, the

summative assessments are considered to be the most of the efficacy of the IB continuum of international education.

Analysis of a scientific paper has helped my chemistry students understanding scientific inquiry. The following areas were investigated:

1. Understanding of scientific papers,
2. Using interdisciplinary science concepts in an authentic, issue-based, problem setting.
3. Carrying out scientific inquiry.

The study engaged the teacher and students within the classroom in standards-based learning, teaching and assessment strategies. It did immerse the teacher in the inquiry of scientific inquiry.

B- Study

During one portion of the extended essay project, the students had the opportunity to read and analyze advanced scientific papers. The papers present a way of integrating science content across disciplines such as biochemistry, pharmacology, organic and inorganic chemistry. The other portion of the project emphasized on active learning. Scientific inquiry based learning, as defined in the National Science Education Standards will be attempted, including evaluating performance using standards based assessment techniques. Classroom evaluation was attempted to assess higher-level cognitive skills such as the ability to apply science knowledge in new situations.

The project for the chemistry students was an investigation that extended over periods of time (2 months). The special issue of "Top Pharmaceuticals" at Chemical and Engineering News looks at 46 drugs that have had a major impact on human health and society. The students were asked to work in groups of 3-4 students.

The teacher provided the students with an index that listed 46 drugs by therapeutic class. The topics that the students choose for their projects were affected by real world application factors. Some of those topics were AIDS, cocain, anticholesterol, abortion, L-Dopa, antihistamine (allergy), vitamins etc. The drug Viagra was not allowed as a choice because of some restriction that the district imposes on discussion of sexual issues in the classroom.

The teacher directed the students to use one specific web site related to the journal of chemical and engineering news. Out of the 16 groups of students, 13 groups (80%) accomplished the first part of the project and provided the researcher with printouts of the medicine. The researcher noticed that some students used other websites and printed out information that did not apply to the purpose of the project. The groups were asked to repeat their searches.

C- Ability to Read with Understanding Scientific Articles

At first, the students were not able to understand the articles. They were not able to gather important information and draw conclusions. The teacher had to provide the students with a second part of the project. Part II consisted of a series of questions about how to look for scientifically important data. After two weeks, the teacher collected 10 reports. Analysis of the reports clearly demonstrated the ability of the students to retrieve

the information that the project was attempting. Apparently, those 10 groups (77%) were able to precisely identify the answers and give meaningful conclusions.

The paragraphs below are copied (without any editing or corrections) from the papers submitted by the chemistry students.

1. "L- Dopa is the treatment of Parkinson's disease. It is caused in the brain. Dopamine is in the brain. Patient with Parkinson lose the ability to produce this enzyme, which cause tremors, rigidity and slowness of movement. Dopamine regulates your blood pressure. The drug L-Dopa is used to store dopamine in the blood vesicles in the presynaptic nerve terminals. The drug is needed to be used in larger doses. L-Dopa has side effects, including nausea and dyskinesias."
2. "AZT is a drug used for the treatment of AIDS (the infection of human immunodeficiency virus). A critical HIV enzyme used the virus RNA genome as a template to build a DNA version that can be inserted into the host's genome. Because AZT has a 3' azido group instead of a 3' hydroxyl group, it can't make the necessary phosphate bend with the next nucleotide. This terminates the synthesis of the DNA copy of the virus RNA genome, preventing integration into the host and blocking viral replication. The drug is expensive. A year's supply cost around $10,000, making AZT unaffordable for those in the developing world."
3. "Allegra: When a susceptible person inhales pollen, the immune system begins pumping out immunoglobulin E (IgE) antibodies that are specific for the pollen proteins. That's how allergies are caused."

4. “Cholesterol lowering, Lovastatin: Akira Endo, a research scientist at Sankyo Pharmaceutical in Japan, discovered statins in 1971. It was introduced in the USA in 1987. The drug is used to lower cholesterol, an essential component that is present in all body cells. In particular, serves to build the cell membranes of the nerve system. The body requires cholesterol through diet or creates it in the liver. This drug works by inhibiting the enzyme HMG-CoA reductase, which is the main regulator of cholesterol synthesis. Statins lower LDL which raising HDL. This how it reduce clogging arteries. Side effect. It has been blamed for memory loss. It also may set off muscles disorder such as myotis or rhadomyosis which is a form of muscle break down”.

D- Ability to Evaluate the Quality of Scientific Information

Ten of the 13 groups (77%) of students were able to evaluate the quality of scientific information. They were able to determine answers to questions derived from curiosity about everyday experience (example are provided in the previous paragraph). They were also able to choose and differentiate between the scientific and non-scientific information in the articles. Three groups of students choose to go to other websites and gather non-scientific statistical information. Their reports were not structured and did not provide good analysis. Below are examples of their reports.

5. “Librium is used in the treatment of anxiety disorder. It is also prescribed for short-term relief of the symptoms anxiety. Librium is habit forming and you can become depend on it. You should take Librium exactly as prescribed. If you miss a dose, you will need to take it as soon as you remember you have not took

the dose. There are some side effects to his and they are if any develop or change in intensity, inform your doctor as soon as possible."

6. "Cocaine was discovered by Albert Neiman. The drug was discovered in 1860. It was published in 1569. Other causes of disease could be other than enzyme. Sometimes it depends on how much you take to treat. You might go to the hospital to get treatment for the drug. You can easily die from the drug if you don't get treatment from using the drug too much. It would cause the brain and body to strive for more as you proceed through the treatment sometimes. Cocaine also cause the release of dopamine from neurons in the brain".
7. " The drug heroin was discovered in Germany (1898) by the Bayer company. When you use heroin, you will feel a warm feeling of relaxation, a sense of pain, fear, hunger and tension. When injected, it reaches the brain in 15-30 seconds. Smoked heroin reaches the brain in around 9 seconds. The drug sold yearly is unknown. It has not been discovered because heroin sold fast daily"

E- Communicating, Science Explanations

As a third part of the project, the students were given the opportunity to communicate their results orally through presentations using the overhead projector. During the presentations, discussions were carried out between the presenter and the classmates. The conversations revealed students' abilities of scientific reasoning. The activity also provided the students with the opportunity to manage ideas and information. Especially, during presentations, the classroom was very quiet and the students were paying a very close attention to the presenter. The teacher interfered in some cases to

explain in more details some of the students' questions. The presentations had to include the important concepts that they had already submitted as reports in the second part of the project.

E- Motivation and Participation

The teacher had a considerable number of groups participating in the project (13 out of 16). The rest of the students did not participate for different reasons such as absences and lack of interest in the chemistry subject. The project tended to motivate the students for some apparent reasons such as:

1- Working in groups

2- Project derived from curiosity about life experiences

3- Large choices of topics that matched student interests (46 drugs)

4- Assistance from the teacher to ease the understanding of scientific topics by providing a series of questions.

5- Oral presentations in the classroom and the undivided attention of the students to the presenter.

6- Giving the project 10% of the final grade.

The articles also presented a way to integrate multidisciplinary concepts that reflects how chemistry is actually practiced. The results revealed that some students were able to recognize the relationship between the interdisciplinary concepts. However, the teacher noticed that this was not necessarily related to their ability to understand the meaning of each concept. Apparently, there was a gap in the students information about

the other fields of science mainly, biology. On the other hand, the students confidently communicate their results orally, in writing and by presenting poster.

F- Conclusion and Implications

The results of this project also indicated that the students could be exposed to a challenging science curricula based on the "real world" of student interaction with nature. To help meet consensus standard of excellence, ACS supports several improvement of curricula such as integrating science content across disciplines and throughout the years of the secondary school experience. In addition, the results of the project indicated that it is possible to enhance the articulation between high schools and two-year colleges.
To teach high school science effectively, adequate facilities and resources are essential. This was a limitation of the project.

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G- Limitations

The science classroom was a traditional one, lacking modern laboratory equipments. There were a sink and 10 tables allowing the students to work in groups. Technology, such as computers in the classroom or permission to use computers in the library was not available. However, these limitations did not have a major effect the study. The materials for the activities were purchased from a supermarket.

The high school building was newly renovated and the library was not ready yet for the students. In addition, there was no accommodation for power point presentations in the classroom to incorporate the use of technology in the classroom.

H- *Teaching for understanding*

David Perkins emphasized that teachers must teach for understanding in order to realize the long term payoffs of education. The project presented a way of connecting chemistry with the students' lives, as an important part of teaching for understanding. The aim was to prepare the students for further learning and more effective functioning in their lives. The students have presented their understanding of a concept in multiple form and representation. Feedback from the teacher and their classmates helped them in fixing any misconception and reinforce the new knowledge. There were ongoing assessments, tapping the potential of powerful representation.

The project met several strategies for successful teaching for understanding (Perkin). Those include:

1. Make learning a long-term, thinking-centered process,
2. Provide for rich ongoing assessment,
3. Support learning with powerful representations,
4. Pay heed to developmental factors,
5. Induct students into the discipline,
6. Teach for transfer.

H- Assessment for Learning

Effective assessment is viewed as a teaching goal to extend versus merely measure instruction.

Assessment for learning (formative assessment) is the most effective in the learning process (particularly, Black and Williams). The teacher took into consideration the important characteristics of assessment for understanding. (Dr. Anne Davies in Thinking in Mind). Those included:

1- where each learner is in relation to the goals

2- where they need to go next

3- and ways to get there

Applying the principles and techniques of assessment for learning made, learning more enjoyable and challenging for both the teacher and the students. Additionally, it assisted in engaging and motivating the students to become better learners and hopefully more successful in their lives.

Dr. Anne Davies posted excellent comments on Assessment for Learning: "The purpose of classroom assessment is to support student learning and to communicate that learning to others". She further commented "When students are engaged in the assessment process, they learn to self-monitor their way to success". The design and progress of the project's assessment proved the efficacy of assessment for learning.

Accordingly, the teacher played an important role in helping the students setting goals, evaluating their progress as well as leading them to reach those goals. Because assessment for learning is an ongoing learning process, it provided information enabling both teachers and students to make adjustments aimed to improve learning. ". It was an efficient assessment that helped the students to realize what they need to know and how

they can achieve learning, with the support and guidance of the teacher. Toward this the teacher kept files for the students and collects evidences for their performance to be analyzed and discussed.

The assessment was authentic in the way that Grant Wiggins explained "Assessment is authentic when we directly examine student performance on worthy intellectual tasks". The authentic assessments offered for the student included a full array of tasks that mirrored effective instructional activities: conducting research; writing, revising and discussing and presenting information. Authentic assessment was present through the multiple tasks that the students have to perform to clarify the inquiry, applying principles, figuring out what to search next and how to apply the information toward more advanced learning.

I- Quality feedback

Other aspects of assessment for learning are listed as characteristics of effective descriptive feedback (Davies, 2007). Out of the seven characteristics, I mostly applied the during-learning feedback making sure that was very specific, clear and within the students' performance capabilities. The teacher had to keep focus the three elements of quality feedback (Black and Williams): recognition of the desired goal, evidence about present position and some understanding of a way to close the gap between the two. It is a differentiated assessment in the sense that it gives each pupil specific guidance on strengths and weaknesses. That is in accord with the National Science Education Standards (National Research Council 1996) "use multiple methods and systematically gather data about student understanding and ability. Each mode of assessment serves

particular purposes and particular students. Each has particular strengths and weaknesses and is used to gather different kinds of information about student understanding and ability".

J- Managed Dialogue

The project proved the effectiveness of managed dialogues in forming the minds of the students and assist them for life long learning.

Dr. Ronald Tharp defined "managed dialogue". The social conversation between the teacher and the student is what forms the minds of the students. During the project, the best structure of assistance was supported through dialogues. Dialogue with a purpose is a managed dialogue. It was managed for an academic purpose and provided academic, social and emotional growth. It was also be a real dialogue allowing mutual exchange of information between the teacher and the student. The teacher assessed on the subject, what the students could say, did and what was needed to be further implemented. Dialogue was a necessity for assessment and for assistance**.**

This was an ongoing, directed and focused assessment for learning. The teacher sets up the targets to be learned and provided the students with directions to reach them. During the process, the teacher constantly monitored the students' activities and readjusts them when needed. Sets of tasks were completed in portions, where the teacher assured that the learning aims of each portion was attained. Most importantly, an educationally well rounded teacher knows for certain where the students should search and what to harvest so that they retain learning and the information they need to become learners for

life. That should fit within the individual interest of each student. A variety of interests formed a homogenous mixture of learning for the whole class. The learning goals and criteria: where each learner is in relation to the goals, where they need to go next and ways to get there were all present in the process.

K- Problematic Scenario

John Barell' stressed that creating and using problematic scenarios is an important way to engage students' interests as well as develop their intellectual abilities. High levels of challenge should be created for all students, not just the average or "gifted and talented" students. In this unit, I tried to apply most of the characteristics of problematic scenario, and they are:

1. Doubt, difficulty, uncertainty, novelty, and mystery which foster curiosity and invites exploration.
2. Complexity: not sure of the outcomes.
3. Boundarylessness: people with different interests participate
4. Robust: Concepts are significant within the unit and curriculum
5. Researchable: Information is available from a variety of sources.
6. Transferability: Concepts may have meaning within other subjects and life contexts.
7. Fascination: captures imagination of our students.
8. "Stickiness": simple, concrete, unexpected, credible, emotional, and story-like.

L- Collaborative Learning

The extended essay project was a successful application of collaborative learning. Collaborative Learning (CL) by definition is an instructional method in which learners work in groups toward a common academic goal. The project proved that CL activities promoted social and academic relationships well beyond the classroom and individual course. CL project processes created environments where students can practice building leadership skills.

Academically, group work trained the students to use collaborative skills and achieve at a higher level of thought. Conversation helped the students retain information and encourage teaching one another. CL reinforced the students' understanding of complex concepts, develops problem solving skills and enhances creativity.

Socially, learners were be actively engaged, present and defend ideas, exchange diverse beliefs and create their own conceptual framework. They practiced trust-building, leadership, decision-making, communication, and conflict management skills. CL helped the students to absorb different perspective, valuing diversity, managing prejudice and bias. All are skills needed for in real life social and employment situations.

Two of the essential elements of cooperative learning were present during the project: 1- clear and complete set of task-completion directions or instructions, 2- Access to must-learn information.

> *"1- CLEAR AND COMPLETE SET OF TASK-COMPLETION DIRECTIONS OR INSTRUCTIONS*
>
> *The teacher need to stated directions or instructions that described in clear, precise terms exactly what students were to do, in what order, with*

what materials, and, when appropriate, what students were to generate as evidence of their mastery of targeted content and skills. These directions were given to students BEFORE they were engaged in their group learning efforts.

2- ACCESS TO MUST-LEARN INFORMATION

The teacher structured the tasks so that students had access to and comprehend the specific information that they must learn. The content focus of learning tasks was certainly aligned directly with the specific outcome objectives and the test items that were used to measure their academic achievement."

M- Differentiated instruction

The extended essay had a differentiating instruction pattern by creating multiple paths allowing the students to take responsibility of their own learning and encouraged peer teaching and cooperative learning. Three elements of the curriculum were differentiated: Content, Process, and Products.

The content was concept-focused and principle driven, adjusted to meet the needs of individual students

Process was differentiated by creating flexible grouping.

Product was differentiated mainly with the assessment. Assessment was used as a teaching tool to extend versus merely measure instruction. The unit was designed to emphasize creative thinking. Ongoing assessment was used to reinforce teaching. Concept maps, presentations, discussion, guided reading and application were used as assessment tools. Students were the active and responsible explorers. Multiple assessment forms differentiated the expectation of the students, yet, reinforced learning.

Most importantly, differentiation was apparent in considering Student interest/ independent study projects. The students were given the choice to choose on the drugs based on their different interests. This proved to be one of the most effective motivations for learning. The teacher played the role of facilitator guiding the student through personally interesting subtopics, while teaching the required concepts. The results exceeded the teacher's expectations. The aim was to develop the skills needed for independent learning.

The environment was also differentiated and manipulated.

N- Interdisciplinary, integrated curriculum

The extended essay project presented a way of integrating science content across disciplines such as biochemistry, pharmacology, organic and inorganic chemistry.

According to Dr. James Comers: The social interaction motivates the desire the learn more. Lev Vygotsky's expanded on Piaget ideas, all learning processes are social

and both teachers and students can assist in the learning process. Additionally, Dr. David Elkin mentioned that integrated curriculum tying different disciplines together is an important form of learning for understanding.

As Dr. Joseph Novack presents in the video, concept map is a powerful tool for learning. It describes the relationship between concepts using linking words. Structure of knowledge: concepts and relationship between concepts constitute knowledge.

"The techniques of probing understanding are concept mapping, prediction-observation-explanation activities, and interviews about concepts, drawings, relational diagram, question production and students' informal writing."

Educational researches on successful teaching encourage multidisciplinary interactive projects and present science in a logical and coherent sequence that reflects the connections among the disciplines.

High school students can be exposed to more intellectually challenging yet developmentally appropriate curricula such as integrating science contents across disciplines. The integrated extended project provided a powerful, meaningful and enjoyable learning experience to the students and brings various aspects of curriculum into meaningful associations. Integrated scientific curriculum has definitely the potential to enlarge the scope of knowledge for the students and helps them perceive new relationships and use their productivities in solving scientific issues.

Integrated curriculum is a great gift to experienced and educated teachers. The expression "every profession should be an authentically woven occupation" put some pressure on the teachers. Teachers are to be well educated, so they maneuver between

the disciplines. Teachers are to be models for transcultural, transreligious, transpolitical and transantional attitude, open to unity and complex plurality.

In facts, three universities, Harvard, Princeton and Columbia, developed recently multidisciplinary courses. The courses proved that it is possible to teach science in an integrated fashion to both science majors and non-science majors. The concepts of the courses were framed in the context of modern problems facing the society, provided a compelling big picture story to constantly remind the students why learning these concepts is essential. At Harvard University, the course is the first step to revamp the life science curriculum, introducing chemistry and biology in a way that reflect how research is done today. The course proved to be very successful. Energetic students filled the largest science center lecture. The professors have designed lab portion of the course to engage students in modern scientific activities. The course has been quite popular with nearly 500 students in the year 2006 and anticipated 1200 students for the subsequent years. (Arnaud, 2006).

O- Webquest:

The students were provided with reliable scientific resource such as Journal of Chemical and Engineering News, a biweekly journal published by the American Chemical Society which is available on-line. In one of its issues, there is a review of the top 45 pharmaceutical discoveries that have a major impact on human health and societies. The students were giving the choice to work in groups or as individuals and engage in reading and analyzing scientific papers to help improving their abilities in

understanding the nature of science. I took the role of facilitator and directed the project in the proper way.

Think: thinkers, inquirers

Example: Have students look at the drugs that changed our world.

Question: What are some of the drugs, of your interest, that have had a major impact on human health and society?

Website: www.CEN-ONLINE.ORG

Look at the issue of June 20, 2005:"Top Pharmaceuticals, A look at drugs that changed our world". Scroll to the indexes at the back. Choose the drug by the therapeutic class, or by the name.

Learn: knowledgeable, open-minded, balanced

Example: Helping the students to

1-Understand how to make connections between the different disciplines,

2- Look into the participation of other cultures in the evolution of the pharmaceutical industry.

3- The intellectual, physical and emotional participation of individuals in the world society toward important achievements.

Question: Look at the drug of your interest and prepare a brief article on the therapeutic effect, the place of discovery considering the participation of experts from all disciplines in the mission.

Website: www.CEN-ONLINE.ORG

Look at the issue of June 20, 2005:"Top Pharmaceuticals, A look at drugs that changed our world". Other related websites are included dependent on your individual choices. You need to look into other disciplines such as chemistry, biochemistry and pharmacology.

Do: risk-taker, caring

Example: helping students to understanding how they can be caring

Question: Based on you choice of the drug, discuss the humanistic, social or cultural reasons associated with your research? How some of the obstacles can be relieved?

Website: www.CEN-ONLINE.ORG

Look at the issue of June 20, 2005:"Top Pharmaceuticals, A look at drugs that changed our world". Other related websites are included dependent on your individual choices. You may choose information related to the cultural and social impact of the discovery. Are all individual in the world able to buy the drug? What are the restrictions imposed? How can these restrictions be relieved?

Reflect: communicator, principled, reflective

Example: Helping the student to be life long learner and researchers as well as getting them used to present, defend their information and be open to make any necessary modifications.

Question: Prepare a presentation of your choice to include the important points discussed above. Be ready to answer explanatory questions from your classmate. Also be ready to defend you opinion and information and be open to suggestions that your classmates may request.

You may use advanced technology for your presentation. Visit: www.atomiclearning.com should you need information about any particular application.

P- Conclusion and remarks.

Reflection on: "IB requires teachers to be analytical, curious, and work collaboratively. IB teachers continually create and change classroom teaching activities to reflect the IB Learner Profile. They also foster an open, interactive, student-centered community."

The results of the project clearly indicated that the pre-high school science education influenced the performance of the students. According to the ACS, teachers can play a pivotal role. They need to be confident in teaching science through interactive and inquiry-based modern courses as defined in the National Science Education Standard. To ensure the K-8 students receive quality science instruction, IBO and ACS supports several plans for teacher development. Their plan include supporting groups of leadership teachers and scientists to operate statewide as teams of in-service facilitators, and using only certified science teacher to teach science at the middle school level.

Parts of the results of this project indicated that the secondary schools students can be exposed to more intellectually challenging yet developmental appropriate curricula to advance the nation in an increasingly complex technological world. The results are in accord with the IBO and ACS views toward developing both a scientifically literate public and science specialist require appropriate curricula taught by well-qualified teachers. The view also supports that teachers need to be comfortable teaching science through interactive and inquiry-based modern courses, and that they need to be appropriately recognized and rewarded for their successes. The release of the National Science Foundation Standards and the Project 2061 Benchmarks challenge current teachers to achieve new levels of excellence in their teaching. The meet the challenge, ACS advocates several ideas to give opportunities for teacher's professional growth, especially in acquiring a stronger scientific background.

Typical classrooms do not give a sufficient presence to thoughtful engagement in understanding performances. To achieve ultimate goal of teaching for understanding in our classrooms, there need to be ongoing assessment and tapping the potential of powerful representation. Pre-service and in-service teacher developments have to emphasis on those areas.

What was available in schools in the past is not enough for the reform needed to create educated generations. Teachers need to continuously develop their teaching strategies. All schools' personnel, teachers, administrators and board members need to be involved in process of learning development. It is very hard to think of a teacher as a center in today's schools. Students should be free to express themselves if they are confused about a subject.

IBO Develops its Curriculum, Practices and Supports Teachers

The International Baccalaureate Research Unit (IBRU) has a role to promote the IB programmes through research-based evidence, stimulate research and form collaboration between the IBO and external research agencies. IB is continuously improving and practices are based on current educational researches in the field of education. (IBO Council of Foundation, 2007e)

An important feature of IB is that it always seeks to improve educational research through collaboration with universities such as that with Harvard Graduate School of Education's on Project Zero on interdisciplinary learning. The project is based on "teaching for understanding" approach which reinforces individualized instruction and teaching concepts through the use of multiple forms of representation to reach for more students. (IB world, 2008a)

Teachers must adopt new classroom techniques to keep ahead in a changing field. They need to be innovative, creative and lifelong learners. IB programmes respond well to those needs. IBO has the priority to find new ways to support teachers in classroom around the world and enrich their teaching repertoires. (Jones, 2008; Marino, 2008, McCallum, 2008; Alchin, 2008)

The IB trains and support teachers through both traditional face-to-face workshops and online. Face-to-face workshops are organized by each IB region throughout the year. A range of teacher support materials and online courses are offered. The Online Curriculum Center (OCC) is an international community of practice for 66

thousand registered IB teachers. To IB trains and supports workshop leaders and online faculty members. (IBO Council of Foundation, 2007e)

Teachers, coordinators and administrators in the IB programmes are continuously sharing their mission to provide an international education through programmes that have been developed using the best-practice teaching and educational experiences from across the world. (IBO Council of Foundation, 2007e)

Q- IB Programme Standards and Practices

The outlines of the project described above reflect the connection to the IB programmes Standards and Practices. The below standards are most apparent:

Standard C1: *A comprehensive, coherent, written curriculum based on the requirements of the programme and developed by the school, is available to all sections of the school community.*

C1-6: The curriculum promotes all the attributes of the IB learner profile.

C1-7: The curriculum encourages students to develop strategies for their own learning and assessment, and to assume increasing levels of responsibility in this respect.

C1-8: The curriculum provides ample opportunity for student inquiry and the presentation of ideas.

C1-9: The curriculum provides opportunities for students to work both independently and collaboratively.

C1-36: The school provides guidance to students on progression to higher education and other career opportunities.

The project encouraged the students to inquirers. During the process, the students were able to acquire knowledge in various fields. It also helped them to develop them as scientific thinkers. They communicated their results in writing, different forms of presentation, and also were give the opportunity to communicate their results and data. Because the project is related to diseases and their treatments, it provided the chance for the students to practice being principled, open-minded, risk-takers, balanced, caring, and reflective.

Standard C2: *The school has implemented a system through which all teachers plan and reflect in collaborative teams.*

C2-3: Planning at the school enables all teachers to gain an overview of the students' whole learning experience.

C2-17: Planning at the school includes the discussion and use of teaching and learning strategies appropriate to the objectives of the separate components of the Diploma Programmes.

The project provided the students with the experience of looking into the nature of higher education scientific careers. Students with different interests had the opportunity to envision future careers. The project also had the potential of involving scientific teachers at the school to reinforce teaching and learning.

Standard C3*: Teaching and learning at the school empowers and encourages students to become lifelong learners, to be responsible towards themselves, their learning, other people and the environment, and to take appropriate action.*

C3-5: Teaching and learning at the school addresses the needs of students who have reached different stages in their development and those who have different learning styles.

C3-7: Teaching at the school engages students as critical thinkers with developing views of their own.

C3-8: Teaching and learning at the school encourages students to take appropriate action in response to their own needs and the needs of others.

C3-9: Teaching at the school meets the needs of students who are not proficient in the language(s) of instruction.

C3-10: Teaching and learning at the school promotes the understanding and practice of academic.

The project did empower and encourage the students to be life long learners and encourage them to be a part of taking action in the efforts to cure diseases.

Standard C4: *There is agreed approach to assessment, and to the recording and reporting of assessment data, which reflects the practices and requirements of the programme.*

C4- 2: Assessment at the school is viewed as being integral with planning, teaching and learning.

C4-7: Students are provided with regular and prompt feedback to inform and improve their learning.

C4-8: Assessment at the school provides students with regular opportunities for reflection on their own learning.

C4-11: Assessment data is analyzed to provide information about the individual needs of students.

C4-12: Assessment data is analyzed to inform the evaluation and subsequent modification of teaching and learning strategies.

C4-19: Student learning is regularly assessed against the objectives and assessment criteria specific to each subject.

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