Inquiry-Based Teaching and Learning of Biotechnological Sciences

(Part.1)

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History of Inquiry Based Science Education

Inquiry learning has been used as a teaching and learning tool for thousands of years, however, the use of inquiry within public education has a much briefer history.

Ancient Greek and Roman educational philosophers focused much more on the art of agricultural and domestic skills for the middle class and oratory for the wealthy upper class.

It was not until the Enlightenment, or the Age of Reason, during the late 17^{th} and 18^{th} century that the subject of Science was considered a respectable academic body of knowledge. Up until the 1900s the study of science within education had a primary focus on memorizing and organizing facts.

John Dewey, a well-known philosopher of education at the beginning of the 20th century, was the first to criticize the fact that science education was not taught in a way to develop young scientific thinkers. Dewey proposed that science should be taught as a process and way of thinking – not as a subject with facts to be memorized. While Dewey was the first to draw attention to this issue, much of the reform within science education followed the lifelong work and efforts of Joseph Schwab.

Joseph Schwab was an educator who proposed that science did not need to be a process for identifying stable truths about the world that we live in, but rather science could be a flexible and multi-directional inquiry driven process of thinking and learning. Schwab believed that science in the classroom should more closely reflect the work of practicing scientists.

Schwab developed three levels of open inquiry that align with the breakdown of inquiry processes that we see today.

1- Students are provided with questions, methods and materials and are challenged to discover relationships between variables.

2- Students are provided with a question; however, the method for research is up to the students to develop.

3- Phenomena are proposed but students must develop their own questions and method for research to discover relationships among variables.

Today, we know that students at all levels of education can successfully experience and develop deeper level thinking skills through scientific inquiry. The graduated levels of scientific inquiry outlined by Schwab demonstrate that students need to develop thinking skills and strategies prior to being exposed to higher levels of inquiry. Effectively, these skills need to be folded by the teacher or instructor until students are able to develop questions, methods, and conclusions on their own.

A catalyst for reform within North American science education was the 1957 launch of Sputhik, the Soviet Union satellite. This historical scientific breakthrough caused a great deal of concern around the science and technology education the American students were receiving. In 1958 the U.S. congress developed and passed the National Defense Education Act in order to provide math and science teachers with adequate teaching materials.

America's National Science Education Standards (NSES) (1996) outlines six important aspects pivotal to inquiry learning in science education.

1-Students should be able to recognize that science is more than memorizing and knowing facts.

2-Students should have the opportunity to develop new knowledge that builds on their prior knowledge and scientific ideas.

3-Students will develop new knowledge by restructuring their previous understandings of scientific concepts and adding new information learned.

4-Learning is influenced by students' social environment whereby they have an opportunity to learn from each other.

5-Students will take control of their learning.

6-The extent to which students are able to learn with deep understanding will influence how transferable their new knowledge is to real life contexts.

Important issues related to the inquiry based learning and teaching of sciences

1-What is inquiry?

– The Characteristics.

Inquiry based learning is a constructivist approach where the overall goal is for students to make meaning. While teachers may guide the inquiry to various degrees (externally facilitated) and set parameters for a classroom inquiry, true inquiry is internally motivated.

Inquiry based learning is an umbrella term that incorporates many current learning approaches (including project based learning, design thinking) and may take various forms, depending on the topic, resources, ages and abilities of students and other variables.

The following are characteristics that serve as hallmarks of inquiry based learning:

- Equal emphasis on process (communicating, reflecting, collaborating, analyzing, etc.,) and content.
- Genuine curiosity, wonderment and questioning (by teachers AND students) are central.
- Student 'voice' is evident – elements of the curriculum / learning are negotiated and student questions are taken seriously and addressed.

- Prior knowledge is ascertained and built upon – formative assessment and subsequent planning is essential.
- Significant concepts and essential questions are identified which unify knowledge and understandings.
- Students are actively involved in constructing understandings through hands-on experiences, research, processing and communicating their understandings in various ways.
- Learning takes place in a social context – students learn from each other, together with others, and from those outside of the classroom context

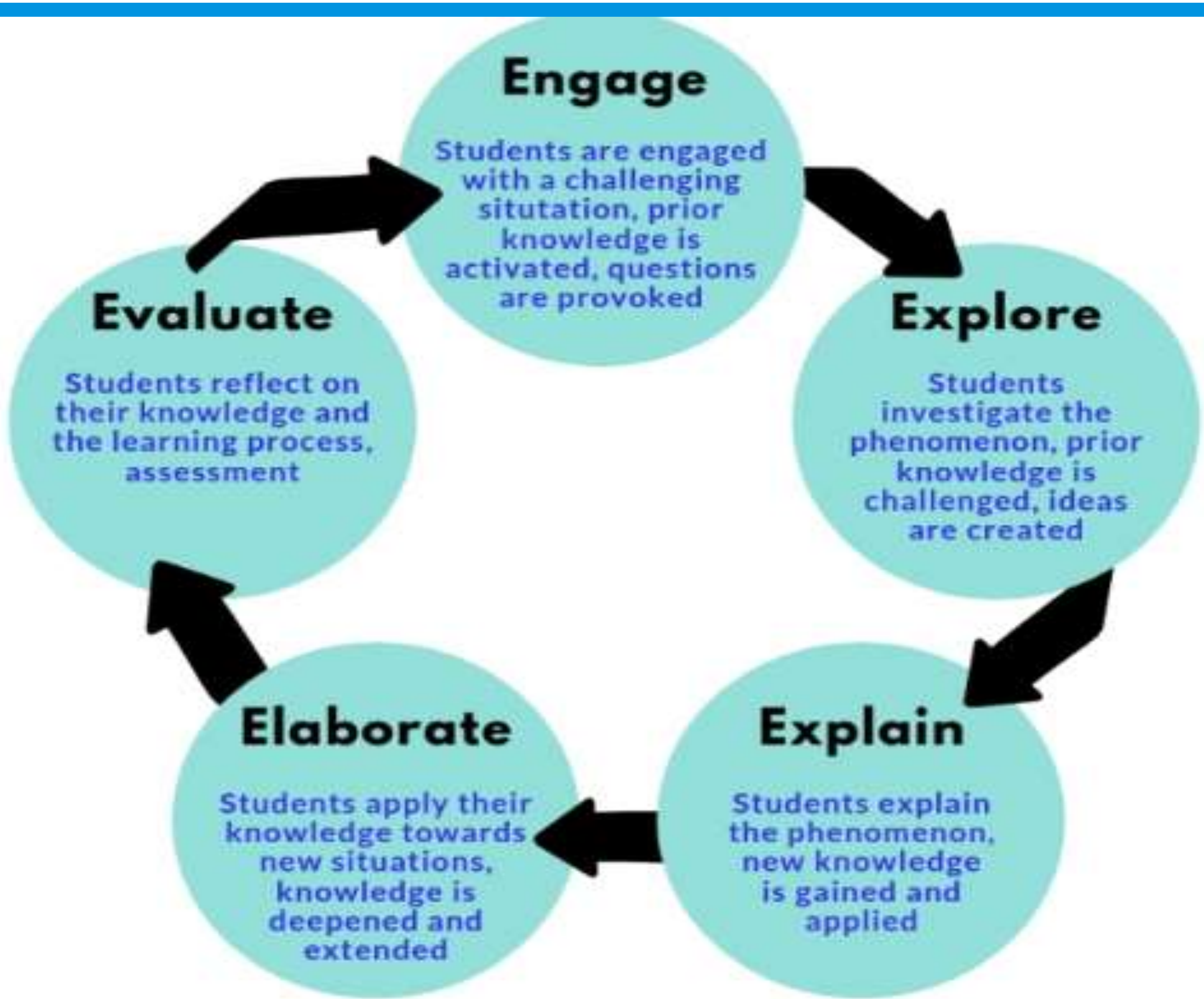
- There is an assumption that understandings are temporal and are constantly reviewed and refined on the basis of new learning and questions – therefore inquiry is ‘recursive’ in nature.
- Reflection, metacognition and depth of thought are valued and planned for assessment is ongoing and clear criteria link performances / products to rigorous curriculum goals.
- Learning leads to action – informing / sharing with others, implementing change, advocacy or taking up further questions or learning.

2-What is inquiry based learning of sciences?

In this sense, inquiry-based science involves students doing science where they have opportunities to explore possible solutions, develop explanations for the phenomena under investigation, elaborate on concepts and processes, and evaluate or assess their understandings in the light of available evidence.

The inquiry learning model utilizes hands-on activities as a way to motivate and engage students while teaching concepts. It stresses the development of knowledge in individuals through active thinking.

The 5E Inquiry-Based Instructional Model is based upon cognitive psychology, constructivist theory to learning, and best practices in STEM instruction (Bybee and Landes 1990). The 5E learning cycle leads students through five phases: Engage, Explore, Explain, Elaborate, and Evaluate. The 5E Instructional Model brings coherence to different teaching strategies, provides connections among educational activities, and helps science teachers make decisions about interactions with students (BSCS 2019). Compared to traditional teaching models, the 5E learning cycle results in greater benefits concerning students' ability for scientific inquiry (Bybee 2009).


Engage
Students are engaged with a challenging situtation, prior knowledge is activated, questions are provoked
Explore
Students investigate the phenomenon, prior knowledge is challenged, ideas are created
Explain
Students explain the phenomenon, new knowledge is gained and applied
Elaborate
Students apply their knowledge towards new situations, knowledge is deepened and extended
Evaluate
Students reflect on their knowledge and the learning process, assessment

Engagement

In this first phase of the 5E Learning Cycle, the teacher gauges student prior knowledge and/or identifies possible misconceptions (Duran and Duran 2004). This student-centered phase should create a desire to learn more about the forthcoming topic. According to Duran and Duran (2004), the engagement phase is not intended for the teacher to lecture, define terms, or provide explanations.

Exploration

The exploration phase provides students with a common base of hands-on activities. These activities will help students use prior knowledge to inquire, generate new ideas, and conduct a preliminary investigation (Bybee 2009). This phase of the learning cycle usually incorporates the main inquiry-based experience, which nurtures students’ understanding (Duran and Duran 2004).

Explanation

The third stage in the instructional model is more teacher-directed and guided by the students' experience in the previous phase (Duran and Duran 2004). Students explain their understanding of concepts and the teacher corrects students' misconceptions (Bybee 2009). During this phase the teacher may provide formal definitions, notes, and labels (Duran and Duran 2004).

Elaboration

In the elaboration phase students are encouraged to apply their new understanding of concepts, while reinforcing new skills (Duran and Duran, 2004). According to Duran and Duran (2004), “Students may conduct additional investigations, develop products, share information and ideas, or apply their knowledge and skills to other disciplines” (p. 53). This stage in the learning cycle presents opportunities for the teacher to integrate science with other content areas (Duran and Duran 2004).

Evaluation

According to Bybee (2009), "The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward achieving the educational objectives" (p. 5). Formative and summative assessment are appropriate in this phase. Duran and Duran (2004) provides a list of non-traditional forms of assessment that are appropriate for evaluating students' understanding and performance: portfolios, performance-based assessment, concept maps, physical models, and journal logs.

According to Williams (2019):

> A focus on content at the expense of process in STEM education (and all education, really) will inhibit student learning, because the important learning occurs through the activities of the process. When the learning of content is necessary so it can be applied, through an activity to a situation, such content is perceived as relevant and so will be learnt more effectively and efficiently. (p. 3)

The 5E Instructional Model serves as a flexible learning cycle that assists curriculum developers, classroom teachers, and school librarians with the creation of STEM lessons that illustrate constructivist, reform-based, best teaching practices.

Learn more about the 5E Instructional Model at BSCS.org.

Works Cited

BSCS Science Learning. 2019. "BSCS 5E Instructional Model." Retrieved from https://bscs.org/bscs-5e-instructional-model/

Phases of Inquiry Based Learning Approach

There are five phases to an inquiry based learning approach. The 5 phases are:

1. **Orientation** – discovering the problem.
2. **Conceptualization** – finding a research question.
3. **Investigation** – collecting evidence and information.
4. **Conclusion** – analyzing the evidence and making up your mind.
5. **Discussion** – exploring the implications of your new knowledge.

<u>3-What is the relation between inquiries based instruction and active learning and students' attitudes?</u>

Inquiry based instruction begins with a question to be answered. Active learning and inquiry based instruction go hand in hand.

- Prince (2004) explains that active learning is, "always active and usually (but not necessarily) collaborative or cooperative,".

- Bishop and Verger (2013) go further stating that, “active learning acts as a superset for both peer-assisted and problem-based learning approaches,”.
- They go on to define both active and inquiry classrooms as student centered learning modalities that work well when combined with the flipped classroom.

Student attitude impacts student performance. Research by Struyven (2005) has shown that active learning environments enable students to achieve a deeper understanding. Active learning helps students learn more thoroughly, have a more positive attitude and have a greater ability to overcome perceived misconceptions.

In Lopatto, 2007 study of undergraduate students from over forty colleges and universities, researchers found that ninety-one percent had a positive experience in an active learning environment and that sixty-eight percent reported an increase in science interest.

According to Struyven (2013), students in her active learning study enjoyed variation in assignments, challenging assignments and found a deeper connection between activities and readings. Learning connections are more easily made with active learning building confidence and increasing student satisfaction.

4-What is inquiry based teaching?

Inquiry-based learning (also enquiry-based learning in British English) is a form of active learning that starts by posing questions, problems or scenarios—rather than simply presenting established facts or portraying a smooth path to knowledge.

The process is often assisted by a facilitator. Inquirers will identify and research issues and questions to develop their knowledge or solutions. Inquiry-based learning includes problem based learning, and is generally used in small scale investigations and projects, as well as research. The inquiry-based instruction is principally very closely related to the development and practice of thinking skills.

Inquiry defined as multidirectional activities where the students make observations, ask questions, gather information from a variety of sources, planning and carrying out the investigation, using evidence to explain the question, use the tool to search, collect and interpret data; propose answers, questions, and predictions; and communicate the findings.

Most students have experience with the direct instruction teaching approach. Classes are lecture based and learning is facilitated by the instructor. This method of teaching implies that lectures are given in class and the lecture is often the first time students are exposed to material. Students are given practice problems or activities to help reinforce concepts taught by the instructor and are eventually tested on their knowledge.

This method places the responsibility of learning on the teacher and his or her ability to deliver the material and keep students motivated. Arguments can be made that an advantage to this approach is that students clearly understand objectives and goals.

Current educational practices, according to Sesen and Tarhan (2010), have been moving away from direct instruction. The “teacher as an information-giver to passive students appears outdated and active learning methods requiring actively participating students have begun to take more interest to help students,”.

- In lab-based inquiry learning, students are encouraged to use more high-level thinking skills, including the ability to think creatively.

Despite using more time than conventional lab, lab-based inquiry could encourage students to design their own steps of investigation based on the problems that arise after their observations of the phenomenon. Teachers should be able to design appropriate learning model according to the times. Therefore as one of the students determining factors in achieving certain competence, teacher needs to be improved to mention his ability on a regular basis.

Teacher Ability to Design Inquiry-based Lab: There are seven aspects that could be expected to support the development capabilities of designing lab: (1) determine the purpose of laboratory activities, (2) determine the type of trial, (3) determine the tools and laboratory materials, (4) determine the test series and describes the diagram, (5) to plan their own experimental procedures, (6) develop inquiry-based worksheets, and (7) designing evaluation laboratory activities.

Current educational literature suggests that inquiry based learning provides a richer educational experience for the learner. Studies over thirty years have lead us to believe that the inquiry based learning model is a more effective learning platform than other passive types of teaching methods.

The inquiry learning approach is characterized by a focus on concepts that are connected, engaging students in activities that allow development of ideas based on outcomes, an emphasis of learning methods which test hypotheses and the belief that content and processes are components that reinforce learning. This type of learning is student driven as opposed to direct instruction which is driven by the teacher.

Students work through the experiment, analyze information and make determinations based on observations. Through this process, they are able to understand from first hand practice how and why things happen in the physical world. In the science classroom, labs are an essential component to learning.

Minner, Levy and Century (2010) believe that utilization of, "hands-on experiences with scientific or natural phenomena were found to be associated with increased conceptual learning," .

The lab experience begins with an observation or the posing of a question. An experiment is then designed to solve the problem. Through inquiry based learning, students are able to verify or refute preconceived beliefs through first hand, hands on experience in the lab. The benefits of inquiry based lessons for learning in the science classroom are many.

In a study performed at the University of Georgia, researchers studied students taking an inquiry based non-major Biology course and found statistically that, “inquiry lab students demonstrated small but significant gains in science literacy and science process skills compared to students enrolled in the traditional cookbook labs,”.

Seen and Tarhan (2010) found statistically that, "applications cause a significantly better acquisition of scientific conceptions, and ensure positive attitudes toward chemistry lesson in comparison with traditional instruction,".

5-What are inquiry-based classrooms features:

- Inquiry-based classrooms featured in the studies allowed students to confront problems, generate and test ideas for themselves, and apply them to new problem situations.
- Students make better connections and become more engaged in the material in that it becomes more meaningful when they are able to pose the questions. More time can be spent in the classroom exploring concepts and developing skills.

6-Why inquiry is based learning important?

Inquiry-based learning also gives students the opportunity to develop stronger relationships with their classmates, improve their communication skills, and increase the confidence they have in their own ideas and ability to contribute in the classroom.

7-Why is inquiry a scientific way of learning?

Inquiry-based science challenges students' thinking by engaging them in investigating scientifically orientated questions where they learn to give priority to evidence, evaluate explanations in the light of alternative explanations and learn to communicate and justify their decisions.

8- What is inquiry based science instruction?

The 5E model of science instruction is a student-centered, inquiry-based process that allows students to learn the science content with more depth.

Achievement gaps are closed when students are led through an inquiry-based multi-sensory learning process.

9- What is an inquiry based lesson plan?

Students actively participate in inquiry learning experiences by developing questions and investigating to find solutions.

… Though inquiry learning is a component of all areas of the curriculum, mathematics and science is the focus of the elementary inquiry lessons.

10- What is inquiry method of teaching?

The inquiry approach is more focused on using and learning content as a means to develop information-processing and problem-solving skills. The system is more students centered, with the teacher as a facilitator of learning.

11- What are learning methods?

- Visual (spatial): You prefer using pictures, images, and spatial understanding.
- Aural (auditory-musical): You prefer using sound and music.
- Verbal (linguistic): You prefer using words, both in speech and writing.
- Physical (kinesthetic): You prefer using your body, hands and sense of touch.

12- What is demonstration method?

A method demonstration is a teaching method used to communicate an idea with the aid of visuals such as flip charts, posters, power point, etc. A demonstration is the process of teaching someone how to make or do something in a step-by-step process. As you show how, you "tell" what you are doing.

13- What is the inquiry approach?

"Inquiry-based learning is an umbrella term, encompassing a range of teaching approaches which involve stimulating learning with a question or issue and thereby engaging learners in constructing new knowledge and understandings." Teachers who use these approaches act as facilitators of learning.

14- What is inquiry based pedagogy?

Inquiry based learning is a broad pedagogical approach which has enjoyed widespread support by educators and education systems over the past decade. Inquiry can be defined as 'seeking for truth, information or knowledge / understanding' and is used in all facets and phases of life.

15- What is discovery based learning?

Discovery learning is an inquiry-based, constructivist learning theory that takes place in problem solving situations where the learner draws on his or her own past experience and existing knowledge to discover facts and relationships and new truths to be learned.

16- What is scientific inquiry based on?

Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work.

17- What are the characteristics of scientific inquiry?

The 5 features of science inquiry (emphasis is mine)

1- Learner Engages in Scientifically Oriented Questions.

2- Learner Gives Priority to Evidence in Responding to Questions.

- Learner Formulates Explanations from Evidence.
- Learner Connects Explanations to Scientific Knowledge.
- Learner Communicates and Justifies Explanations.

18- What is an example of scientific inquiry?

For example, sometimes you may make a new observation after conducting research. Scientists generally begin by making an observation.

They explore and collect information with their senses (smell, sight, sound, touch, and taste) and ask a question that they would like to answer.

19- What is problem solving method of teaching?

Problem-based learning (PBL) is a student-centered pedagogy in which students learn about a subject through the experience of solving an open-ended problem found in trigger material. ...

The PBL tutorial process involves working in small groups of learners.

20- What is guided inquiry learning?

The guided inquiry process puts the emphasis on scientist in "student-scientist." The primary objective of guided inquiry is to promote learning through student investigation. This material is designed to assist teachers in targeting higher-level thinking and science process skills for their students.

21- What are 3 types of learning?

Visual, Auditory, and Kinesthetic Learning Styles (VAK) The VAK learning style uses the three main sensory receivers: Visual, Auditory, and Kinesthetic (movement) to determine the dominant learning style. It is sometimes known as VAKT (Visual, Auditory, Kinesthetic, & Tactile).

22- What are the 8 different types of learning styles?

1. **The Linguistic Learner.**
2. **The Naturalist.**
3. **The Musical or Rhythmic Learner.**
4. **The Kinesthetic Learner.**
5. **The Visual or Spatial Learner.**
6. **The Logical or Mathematical Learner.**
7. **The Interpersonal Learner.**
8. **The Intrapersonal Learner.**

Overview of Learning Styles

Many people recognize that each person prefers different learning styles and techniques. Learning styles group common ways that people learn.

Everyone has a mix of learning styles. Some people may find that they have a dominant style of learning, with far less use of the other styles. Others may find that they use different styles in different circumstances.

There is no right mix. Nor are your styles fixed. You can develop ability in less dominant styles, as well as further develop styles that you already use well.

Using multiple learning styles and multiple intelligences for learning is a relatively new approach.

This approach is one that educators have only recently started to recognize. Traditional schooling used (and continues to use) mainly linguistic and logical teaching methods.

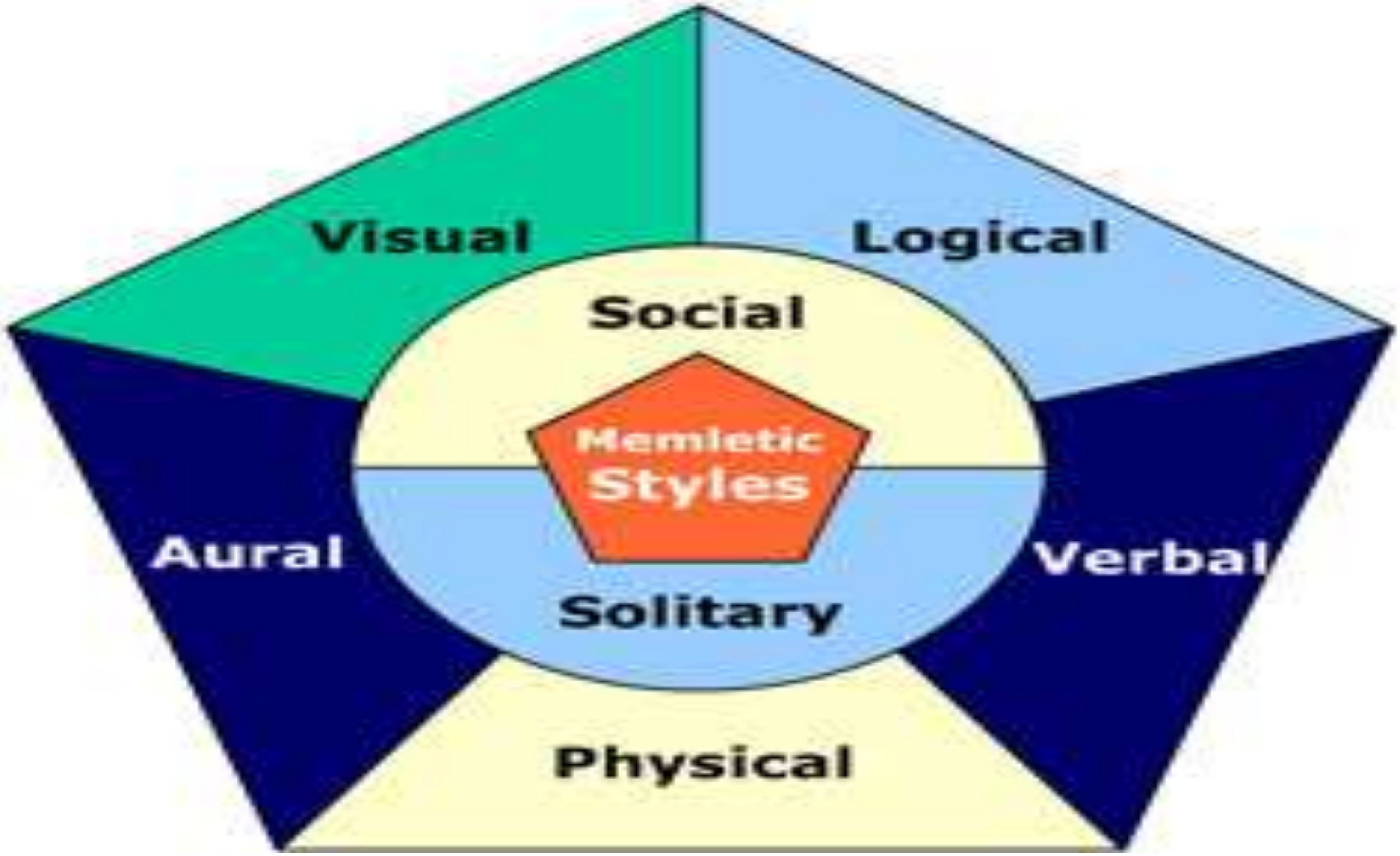
It also uses a limited range of learning and teaching techniques. Many schools still rely on classroom and book-based teaching, much repetition, and pressured exams for reinforcement and review.

A result is that we often label those who use these learning styles and techniques as bright. Those who use less favored learning styles often find themselves in lower classes, with various not-so-complimentary labels and sometimes lower quality teaching. This can create positive and negative spirals that reinforce the belief that one is "smart" or "dumb".

By recognizing and understanding your own learning styles, you can use techniques better suited to you. This improves the speed and quality of your learning.

The Seven Learning Styles:

1. Visual (spatial): You prefer using pictures, images, and spatial understanding.
2. Aural (auditory-musical): You prefer using sound and music.
3. Verbal (linguistic): You prefer using words, both in speech and writing.
4. Physical (kinesthetic): You prefer using your body, hands and sense of touch.
5. Logical (mathematical): You prefer using logic, reasoning and systems.
6. Social (interpersonal): You prefer to learn in groups or with other people.
7. Solitary (intrapersonal): You prefer to work alone and use self-study.


Visual
Logical
Social
Memletic
Styles
Aural
Verbal
Solitary
Physical

23-What are the three basic types of learning?

There are three main types of learning: classical conditioning, operant conditioning, and observational learning. Both classical and operant conditionings are forms of associative learning, in which associations are made between events that occur together.

24-What are the methods of teaching?

That is why I would recommend the use of complementary methods rather than one method.

- **LECTURE METHOD. A lecture is an oral presentation of information by the instructor. ...**
- **THE DISCUSSION METHOD. Discussion involves two-way communication between participants. ...**
- **THE DEMONSTRATION LESSON. ...**
- **BUZZ GROUPS. ...**
- **BRAINSTORMING. ...**
- **ROLE PLAYS.**

25-What is an inquiry based project?

Inquiry-based project work involves a group of students investigating a worthy question, issue, problem, or idea. This is the type of authentic project work that those working in the disciplines actually undertake to create or build knowledge. These projects involve serious engagement and investigation.

26- What are the three types of inquiry?

The three types of inquiries, in solving ethical problems are: normative inquiry, conceptual inquiry, and factual or descriptive inquiry. The three types of inquiries are discussed below to illustrate the differences and preference.

27- What is the greatest challenge to implement an inquiry based teaching approach?

The greatest challenge to implementing an inquiry based teaching approach is time. As time is often seen by teachers as a constraint, proper planning and time management are important components that must be considered prior to incorporating the inquiry based learning platform.

According to Prince (2004), it is, “important to ensure that lessons are designed around important learning outcomes,” and that they “promote thoughtful engagement”.

In the chemistry classroom, a vast amount of time is spent in lecture, discussion of concepts and solving problems.

In order to facilitate a slower paced learning classroom, a variety of strategies were utilized to help students understand required content. To promote inquiry based learning, I was able to remove time devoted to lecture.

During this study, online resources were provided to the students to support their understanding of difficult concepts and to help with problem solving. To better meet the needs of my students, online resources in the form of notes, sample problems and video clips via my teacher web page were provided. Placing responsibility on the students to learn materials that were traditionally taught in the classroom is referred to as a flipped classroom.

Fulton (2012) describes the benefits of the flipped classroom, "With class time freed up from lectures, teachers are developing open-ended, cross-curricular projects that actively engage students and bring real-life relevance,". The flipped class room allowed students to look at notes and return to them as needed, gain additional support when convenient and reinforce their problem solving skills with simple to difficult problem examples.

What are the Characteristics of inquiry- based learning?

Specific learning processes that people engage in during inquiry-learning include:

- Creating questions of their own.

- Obtaining supporting evidence to answer the question(s).

- Explaining the evidence collected.

- Connecting the explanation to the knowledge obtained from the investigative process.

- Creating an argument and justification for the explanation.

Inquiry learning involves developing questions, making observations, doing research to find out what information is already recorded, developing methods for experiments, developing instruments for data collection, collecting, analyzing, and interpreting data, outlining possible explanations and creating predictions for future study.

Teachers should be encouraging divergent thinking and allowing students the freedom to ask their own questions and to learn the effective strategies for discovering the answers. The higher order thinking skills that students have the opportunity to develop during inquiry activities will assist in the critical thinking skills that they will be able to transfer to other subjects.

Inquiry-based learning can be done in multiple formats, including:

Field-work.

Case studies.

Investigations.

Individual and group projects.

Research projects.

Suggested approaches of inquiry based learning

1. Concept Cartoon.
2. Concept Mapping.
3. Cooperative Learning.
4. Demonstration.
5. Field Trips.
6. Games.
7. Investigation.
8. Problem Solving.

9. Projects.

10. Questioning.

11. Role Play, Drama, Dance and Movement.

12. Stories.

13. Strategies for Active and Independent Learning (SAIL).

14. Information and Communication Technologies.

15. National Education.

16. Ethics and Attitudes Criticism.

Remember to keep in mind…

- Teacher is Facilitator in IBL environment.
- Place needs of students and their ideas at the center.
- Don't wait for the perfect question, pose multiple open-ended questions.
- Work towards common goal of understanding.
- Remain faithful to the students' line of inquiry.
- Teach directly on a need-to-know basis.
- Encourage students to demonstrate learning using a range of media.

Inquiry-Based Teaching and Learning in Biotechnology

Inquiry-Based Teaching and Learning in Biotechnology

Research on the use of inquiry-based biotechnology instruction is very limited. However, what little is out there does support that it has the capacity to benefit biotechnology education in much the same way that is has other science disciplines. In a study of 321 students in six high school biology classes using a microscopy and biotechnology curriculum redesigned collaboratively between high school teachers and university faculty to incorporate active learning-based laboratory units, Taraban, Box, Myers, Pollard, and Bowen (2007) found that students using the inquiry-based curriculum performed significantly ($p < 0.001$) better in both the microscopy and biotechnology labs.

In another study, Bigler and Hanegan (2011) found student content knowledge increased after a hands-on biotechnology intervention, Project Crawfish, was implemented in secondary biology classrooms. When comparing groups on the areas of DNA extraction/gel electrophoresis, PCR, DNA sequencing, bioinformatics, and phylogenetics, the ninety-three students in traditional classrooms only showed significant increases for PCR and DNA sequencing ($p = 0.0459$ and $p = 0.0043$, respectively), while the 125 students in the inquiry classrooms showed significant increases in all areas ($p = 0.0027$, $p < 0.0001$, $p = 0.0007$, $p = 0.0004$, and $p = 0.0128$, respectively).

Bethel and Lieberman (2014) designed a multidisciplinary guided-inquiry biotechnology unit focused on the three-dimensional structure of proteins, their function, and connection to disease. At the time their article was published, the unit had been taught to eighty-two students, and cumulative comparisons of pre and posttests showed marked improvements in student achievement (36 +/- 15% on pre-tests compared to 80 +/- 11% on posttests) in the areas of protein structure, the molecular basis of disease, and the scientific process.

As with inquiry-based instruction in science in general, inquiry-based instruction in biotechnology has also proven successful at the post-secondary level. In a university molecular biology course, through the incorporation of project-based learning, a form of inquiry-based instruction, students showed improvements in laboratory technical skills in the areas of cloning, transfection, expression, and protein purification.

In another molecular biology curriculum redesign, researchers found students made gains in technical skills areas such as bioinformatics and bibliographic searches, as well as cDNA templates and cloning vectors, polymerase chain reaction (PCR) amplification, and restriction and ligation reactions. Conceptual understanding and technical skills were also improved in a cellulose-cellulase lab redesigned by Ketpichainarong, Panijpan, and Ruenwongsa (2010). Understanding of three main enzyme topics were significantly higher ($p < 0.001$) compared to pretest scores, and increases were highest in the application aspects and methods for measuring enzyme activity.

Using inflammation in macrophages as a model system, Gunn, Seitz McCauslin, Staiger, and Pirone (2013) developed a structured inquiry-based biotechnology laboratory curriculum which resulted in ninety-five percent of their students successfully meeting learning outcomes in the areas of transfection and luciferase reporter assay, immunoblot, fluorescence microscopy, enzyme-linked immunosorbent assay, and quantitative polymerase chain reaction.

Incorporating inquiry-based instruction into biotechnology curriculum has also successfully led to gains in student attitude and motivation at both the secondary and post-secondary levels. For example, Klop et al. (2010) redesigned a science module on the topic of cancer and modern biotechnology based on social constructivist learning theory and conducted a quasi-experimental study regarding secondary school students' attitudes towards modern biotechnology.

Questionnaires from 365 students were analyzed via chi-square and significant differences ($p < 0.05$) were obtained between control and constructivist classrooms, resulting in a more positive attitude toward modern biotechnology from the experimental group. The study by Movahedzadeh, Patwell, Rieker, and Gonzalez (2012) also supported increased interest in STEM-related fields, as well as improvements in student self-confidence.

Student questionnaires from the study by Taraban, Box, Myers, Pollard, and Bowen (2007) showed a preference for active-learning and that students perceived greater learning gains in biotechnology after completing the labs compared to traditional instructional methods. Though students, in the study by Lesmes Celorrio, Fernandez Gomez-Chacon, and Gonzalez-Soltero (2013), found time management of the projects to be the biggest challenge, they did find the ability to present their findings to be the most positive aspect of the process.

Student assessments from another study also revealed, when inquiry-based instruction is incorporated with biotechnology education, students showed improved perceptions regarding personal relevance, scientific uncertainty, critical voice, and attitude, but not in the area of shared control. Student interviews in this same study revealed they felt more active in their learning, that topics were more relevant, and they had more opportunities to investigate their own problems, communicate their ideas and data with peers, and to draw their own conclusions through the use of their own evidence compared to traditional instruction.

Though science educators express great enthusiasm for inquiry-based instruction, the lack of implementation is often explained by a lack of understanding on the part of the teachers. Many view it as an approach that requires significant time and materials to develop and more time and effort on the part of the students and a method that is difficult to manage in traditional classroom environments. Successful implementation is also inhibited by teachers' lack of confidence in their content knowledge, as well as their pedagogical and theoretical knowledge.

The implementation of biotechnology education suffers from barriers similar to those encountered by the implementation of inquiry-based instruction in other science disciplines.

Although biotechnology is a current and relevant field and biotechnology education is supported by the Life Science standards for graded 9-12 and the Framework for K-12 Science Education, the inclusion of biotechnology topics in high school science classes is still minimal at best.

The lack of implementation can be explained by a number of factors: teachers' need for more information related to subject matter knowledge and instruction practices; teachers' perceptions about the subject may impact their instructional decisions; teachers' concerns regarding student impact; and teachers' inability to determine where biotechnology fits within the curriculum. Though research on the use of inquiry-based instruction in the area of biotechnology is limited, it does indicate that the benefits are similar to what they have been for other science disciplines.

Given that inquiry focuses on a student's ability to be at the center of their own learning, and the fact that biotechnology is a topic that requires hands-on learning for students to fully understand cell and molecular techniques, there is a unique intersection that allows these two aspects of education to work hand in hand. And, given the lack of widespread implementation of either of these, this intersection would benefit from further investigation.

Lesmes Celorrio, Fernandez Gomez-Chacon, and Gonzalez-Soltero (2013) recommended steps in adapting

introductory science courses to inquiry-based learning. First, identify a biological or medical problem which is both related to student interest and constitutes a key experimental objective for the course. Second, develop a research project that includes key skill development for the laboratory. Third, encourage students to be flexible and work on the protocol in order to improve results of the experiment.

Project Based Learning

in kindergarten

Problem-based learning in an on-line biotechnology course

What is PBL?

Problem-based learning (PBL), also known as case-based learning, is an increasingly integral part of education reform in the United States and around the world. The essence of PBL can be summarized as the use of a "real world" problem or situation as a context for learning.

The purpose of PBL is to increase education's relevance to the perceived needs of the professional community, to increase the development of critical thinking, to engage student interest, and to increase the problem-solving abilities of graduates, with the use of situations or problems presented in class that resemble reality. PBL is a student-centered approach to learning, facilitating the construction of a conceptual network of knowledge in students, which can be subsequently applied in a wide range of practical settings. In many cases, the realistic problems used in PBL studies may not have a right or wrong answer.

PBL is conducted by introducing students to situations or problems that resemble reality. It can be used to make the construction of a conceptual network possible, increasing the probability of retention of the general objectives of the problem-based unit.

PBL works through five cognitive areas to stimulate learning:

1) activation of students' prior knowledge 2) elaboration of prior knowledge through cooperative discussions 3) restructuring of knowledge to fit the problem presented; construction of an appropriate semantic network through internal discourse 4) learning in the scaffolding context of a real-world problem 5) emergence of epistemic curiosity due to relevance of problem.

In the PBL environment, students should be allowed to analyze the problem in its own and the student's contexts and environments. Students must construct a method to arrive at a detailed analysis, if not a final conclusion (this process is sometimes referred to as "situation-based learning"; Dockett and Tegel, 1993; Russell et al., 1994). While the specifics of how the students will arrive at an analysis must be determined by the students themselves based on their own perceptions of what information is needed, such as how to divide the labor, the instructor may provide guidance in the form of a structured decision-making process.

A gestalt impression is certainly a valid way to arrive at a good decision, but it is difficult to defend a decision that is not arrived at in a very logical and careful fashion. Care must be taken to ensure that students are not forced to follow one particular logical path to a predetermined conclusion (sometimes referred to as "solution-based learning"; however, for an opposing viewpoint on the importance of actually solving the problem.

In PBL, the focus is on the process, not the product. Learning objectives in PBL situations include the development of critical thinking skills, development of a high professional competency, development of problem solving abilities, acquisition of knowledge, development of the ability to work productively as a team member and make decisions in unfamiliar situations, and acquisition of skills that support self-directed life-long learning, self-evaluation, and adaptation to change. These learning objectives are typically achieved when certain conditions exist with regards to the problem presented, and when these conditions can be remedied by the design of the PBL assignment.

The four conditions which need to be fulfilled by the PBL design are:

1) The student should be unhappy with the current state of his or her current knowledge to solve the problem.

2) The new concepts should be intelligible, plausible, and understandable.

3) The new concepts should be immediately applicable to the problem.

4) The new concepts should be more applicable to the problem than the learner's previous knowledge.

PBL has the advantages of providing a forum where a design process can be used to arrive at a solution, generating the need to look at other study disciplines that contribute to the problem-solving process.

The PBL environment is also very flexible in allowing any depth of knowledge that the instructor desires. In some cases, students can also enter and exit the problem at any level without any loss of understanding or without needing a priori knowledge base, although the withdrawal of students can create problems in a cooperative learning group.

PBL promotes studying for meaning and long-term understanding rather than studying for short-term recall on an exam, though results in the literature for overall knowledge acquisition through PBL are mixed. PBL also provides an excellent connection between the traditional college educational setting and continuing and extended education. Finally, in the nature of its interactive approach between thinking, discussion, and searching for more information, PBL mimics the approach that many people usually take to problems in real life.

PBL assignments typically occur in several stages:

1) The problem is encountered first, before any formal study has been conducted.

2) The problem is presented to students in the same way that it would be faced in reality.

3) Students work with the problem in such a way that permits their reasoning and application of knowledge to be challenged and assessed.

4) Needed areas of learning are identified by the students and used as a guide to individualized study.

5) The skills and knowledge acquired are applied reiteratively to the original problem.

6) The learning that has occurred is integrated into the students' existing knowledge and skills.

The role of the instructor is quite different between PBL and the more-traditional lecture-based instructor-centered environment. In classical PBL, the instructor interferes as little as possible in the group's discussions about their science and research (although there is still an extensive role for the instructor in helping students locate sources for research, monitoring their progress through authentic learning activities, and handling interpersonal disputes in dysfunctional groups in an even-handed manner).

Students are often initially uneasy with a non-interfering-in-course-material instructor since they are used to being told what is right and what is wrong, but usually they eventually grow more comfortable with the situation as they assume responsibility for their own learning.

However, a greater depth of understanding is achieved with an interactive facilitator who helps steer the students towards successful solving of the problem than with a completely passive instructor. The identity of who is leading the PBL group also has an impact on PBL outcomes.

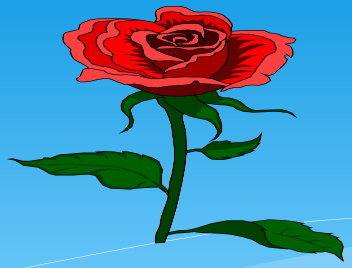
Steele et al. (2000) found that, in medical schools, peer-led student groups tended to take shortcuts that might undermine some of the intended goals of PBL, and that learning outcomes are higher in PBL classes that have a tenured faculty member as the instructor than in those in which the instructor is a post-doctoral fellow.

Problem-based learning (PBL) is a pedagogical tool that uses a "real world" problem or situation as a context for learning. PBL encourages student development of critical thinking skills, a high professional competency, problem-solving ability, knowledge acquisition, the ability to work productively as a team member and make decisions in unfamiliar situations, and the acquisition of skills that support self-directed life-long learning, metacognition, and adaptation to change. However, little research has focused on the use of PBL in on-line "virtual" classes.

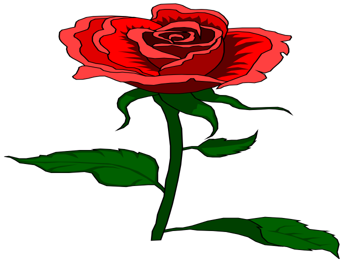
Two studies were conducted exploring the use of PBL in an on-line biotechnology course. In the first study, ethical, legal, social, and human issues were used as a motivation for learning about DNA testing technologies, applications, and bioethical issues. In the second study, we combined PBL pedagogy with a rich multimedia environment of streaming video interviews, physical artifacts, and extensive links to articles and databases to create a multidimensional immersive PBL environment called "Robert's World".

In "Robert's World", a man is determining whether to undergo a pre-symptomatic DNA test for an untreatable, incurable, fatal genetic disease for which he has a family history. In both studies, design and implementation issues of the on-line PBL environment are discussed, as are differences between on-line PBL and face-to-face PBL. Both studies provide evidence to suggest that PBL stimulates higher-order learning in students.

However, in both studies, student performance on an exam testing acquisition of lower-order factual learning was lower for PBL students than for students who learned the same material through a traditional lecture-based approach. Possible reasons for this lower level of performance are explored. Student feedback expressed engagement with the issues and material covered, with reservations about some aspects of the PBL format, such as the lack of flexibility provided in cooperative learning.



THANK YOU



Inquiry-Based Teaching and Learning of Biotechnological Sciences

(Part.2)

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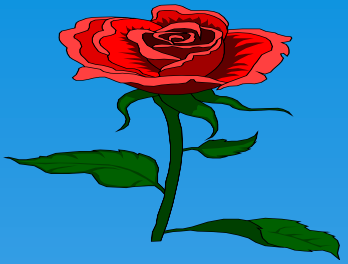
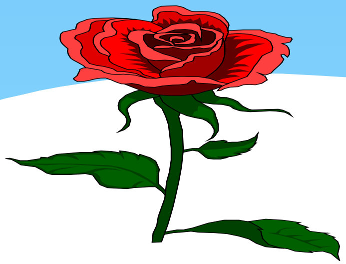


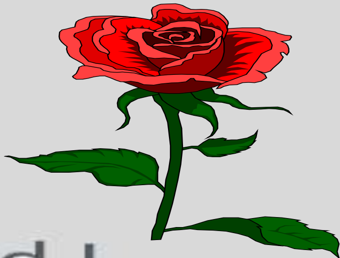
Cases Studies

(All Over The World)



Improving Quality of Primary Education in Pakistan

by Riaz Haq
Jan 7, 2012



Tell me and I forget, show me and I remember, involve me and I understand.

Improving quality of education is just as important as broadening access to it for Pakistan to reap full demographic dividend of its young population. Inquiry-based learning is an important pillar of the efforts undertaken by Pakistan Science Foundation (PSF) and The Citizens Foundation (TCF) to improve quality of education.


Ask
Investigate
Create
Discuss
Reflect

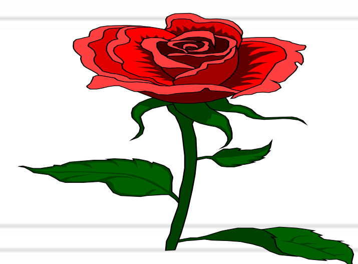
Introducing Phytochemical Testing of Sandoricum koetjape Merr. Through Inquiry-Based Learning

Conference Paper · January 2017

DOI: 10.5220/0007305003950398
Conference: 2nd Asian Education Symposium

Leny Heliawati

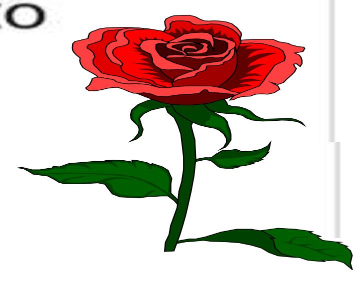
Didit Ardianto
3.38 · Universitas Pakuan



Sun Theo C.L. Ndruru
2.22 · Bandung Institute of Technology

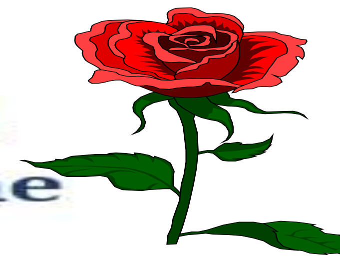
Phytochemical testing of natural products is one of the interesting topics in the chemistry research. So, it's necessary to introduce for Senior High School students. Currently the phytochemical testing laboratory (lab) manual of Sandoricum koetjape Merr, has been successfully performed, focussed on the secondary metabolites findings of flavonoids and alkaloids. The experiment method of the verified-lab manual can be implemented in a practicum-based inquiry learning. Experiment of lab activities increased students understanding and knowledge about phytochemical test of secondary metabolites of Sandoricum koetjape Merr., which were confirmed by all students/groups achieved hypothesis successfully, a highest post-lab assignment score and students ability to conclude their experiment.

conclude their experiment.



OXFORD UNIVERSITY PRESS

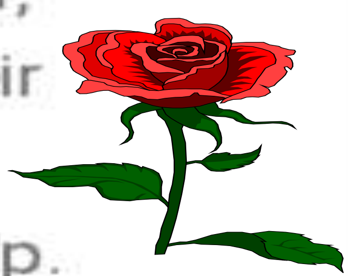
English Language Teaching Global Blog



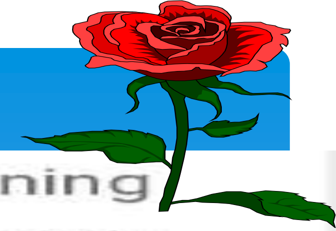
Inquiry-based Learning: 4 essential principles for the ELT classroom

29 January 2020 by Oxford University Press ELT | 1 Comment

Allowing students greater agency in their learning can be a liberating experience. Rather than the teacher as expert, inquiry-based learning allows learners to assume the responsibility of becoming experts of the knowledge they are constructing through a process self-discovery and trial and error, while the teacher's role is to monitor their students' process of constructing new meaning and step in when they need help.



This is the very core of inquiry-based learning (IBL), a form of learning where students pose their own research questions about a topic and set out on a journey to answer them. The benefits of inquiry-based learning are many,

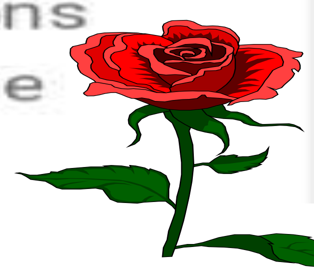


This is the very core of inquiry-based learning (IBL), a form of learning where students pose their own research questions about a topic and set out on a journey to answer them. The benefits of inquiry-based learning are many, such as:

- Supporting students to build their own initiative.
- Encouraging a deeper understanding of the content.
- Motivating students to form their own connections about what they learn.
- Students taking more ownership of their learning and a sense of reward not just from a final product, but from the process of knowledge-making itself.
- Helping students develop the critical thinking and life skills necessary to be competitive in the 21st century, from problem-solving to effective collaboration and communication (Ismael & Elias, 2006).

IBL is often employed in math and science classrooms, which naturally lend themselves to a problem-solving approach. (Amaral et al. 2002, Marshall & Horton, 2011). However, the framework certainly has potential for other disciplines as well, including English (Chu et al., 2011). Of course, balancing inquiry-based learning with language learning means that teachers must also attend to the language and vocabulary skills students need to be effective inquisitors. Tweaks to the traditional model can make this become a reality.

Below are four key principles that distinguish an inquiry-based approach, and suggestions on how teachers can scaffold them for the English language classroom.



1) Students as Researchers

In a typical inquiry-based learning framework, students are introduced to a topic and tasked with developing their own research questions to guide their process of discovery (Pedaste et al., 2015). In an English language setting, one way to model this is to provide a leading question for the students, choosing one that is open-ended and can lead students in more than one direction. Even yes-no questions can provide such ambiguity, for by doing deeper research, students begin to realize that the answer is not always black-and-white.

Take the question, *Are you a good decision maker?* We can encourage students to ask related questions that encourage more informed responses:

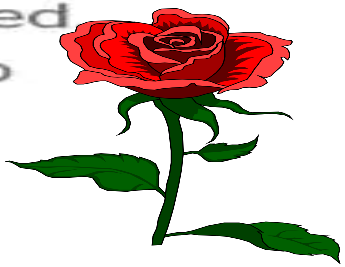
- *How do people solve problems differently?*
- *What emotional and biological factors influence people's decision making?*
- *What role does personality play?*

Students can use WebQuests to find relevant articles and videos to look at the question from multiple perspectives. In a more scaffolded setting, instructors can provide articles and videos to discuss as a class, and ask students to draw out the relevant ideas and identify connections. Either way, the goal is to have students revisit the question each time new information is learned so they can elaborate on and refine their answers, and in doing so, slowly become experts on the topic.

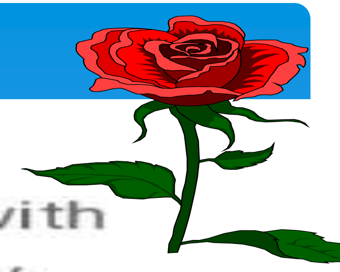
2) Teachers as Research Assistants

An inquiry-based learning model often flips the roles of the teacher and student. Students become the researchers, and teachers assume the role of the assistant or guide to their learning (Dobber et al., 2017). One way to encourage this is to flip the classroom itself so that instructional lessons are delivered online, and class time is devoted to students applying what they have learned through practice and collaborative activities.

As language teachers, we can direct students to instructional videos on skills they'll need to understand and respond to the texts they encounter. An instructional video on how to classify information could support a text about different kinds of problem solvers, for example. Videos on relevant grammatical and language structures can also be assigned. Teachers can then use class time not to present the material, but to attend to students' questions and curiosities.

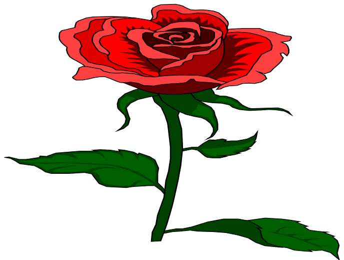


3) Peer-to-Peer Collaboration



Learning from peers and sharing ideas with others is another core principle of inquiry-based learning. Students in an IBL classroom become each other's soundboards, which gives them an authentic audience from which to draw alternative perspectives from their own and test the validity of their ideas (Ismael & Elias 2006). Students are meant to collaborate throughout the entire process, from their initial response to the question to the final project. To do this, teachers can pose the leading question on an online discussion board and require peers to respond to each other's ideas. To scaffold, teachers can provide language used to respond to posts, such how to acknowledge someone else's ideas (*I think you're saying that...*) or show agreement or disagreement (*I see your point, but I also wonder...*).

Collaboration also takes places through the final project. IBL classrooms typically have students complete the cycle with group projects, such as debates, group presentations, newsletters, and discussions. Even if students are working independently on personal essays, teachers can have them conduct peer reviews for further feedback, and to present their findings and insights to the class, thereby providing them with a wider audience than just the teacher.



4) Reflecting on Learning

The final principle is asking students to reflect on their learning (Pedaste et al., 2005). This can be achieved by posing the leading question on the discussion board at the end of the cycle, to see how students' responses have evolved based on what they've learned. Language teachers can also encourage reflection through assessment feedback. If giving a test on the language and skills students have studied, they can go a step further by posing questions about the experience:

- *How difficult did you find the test?*
- *Why do you think you made mistakes?*
- *What can you do to improve your learning?*
- *What can your teacher do?*

This helps students identify areas for improvement, and it gives teachers guidance in tailoring their instruction in the future.

In the IBL classroom, students are in the driver's seat, but teachers are not sitting alone in the back. They're upfront, in the passenger seat, watching students navigate their way and giving direction when they get lost. The teacher knows that the path of inquiry can take multiple routes and that students will need different tools to get to their final destination. With proper scaffolding, teachers can make the voyage for English language learners more successful, and in the process, create a cohort of lifelong inquisitors.

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Enhancing Student Experience in Plant Sciences through Inquiry Based Learning:

(New Mexico State University)

Many students at land grant universities start their undergraduate studies with an undecided major or switch from major to major during their undergraduate career. With so many competing and more lucrative career options, recruiting undergraduate students into Plant Sciences is a challenge.

Developing and maintaining an interest in agricultural majors is equally important in retaining those students who do enter into agricultural fields. Innovative and entertaining ideas must be applied to motivate and attract students towards plant sciences.

One solution is a needed paradigm shift from traditional textbook-focused instructional methods to of inquiry based learning, where students exploring challenging questions appropriate to the field (Crawford, 1999).

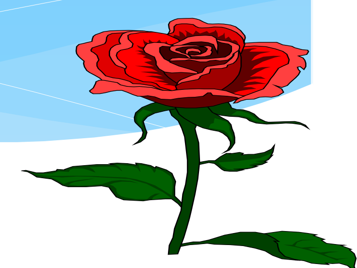
Inquiry-based learning is an active form of learning and enhances students' self-engagement with scientific activities (Edelson et al., 1999) resulting in an open environment in which students design their learning through exploration with the subject matter. An essential component of inquiry-based learning is that students work independently to solve problems rather than passively receiving direct, step-by-step instructions from the teacher.

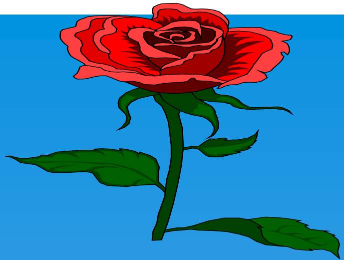
The instructor does not provide knowledge, but instead helps students along the process in discovering knowledge themselves.

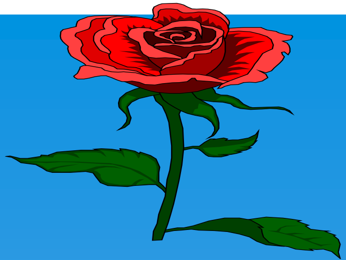
This note provides an example of how a fun-filled, hands-on inquiry based learning model implemented in a general education introductory plant science course helped stimulate interest about plants in non-agriculture major students at New Mexico State University.

In addition, the project as designed promotes problem-solving, team-work and presentation skills among students.

In an effort to increase student interest in plant sciences and make students aware of 1) the tremendous variety of plants, 2) the importance of plants in daily life, 3) plant origins, 4) plant production and management practices, and 5) fun facts about plants, the instructor developed a multi-faceted project "Know Your Plant Project." For this project, student teams are assigned a "mystery" plant or plant product.





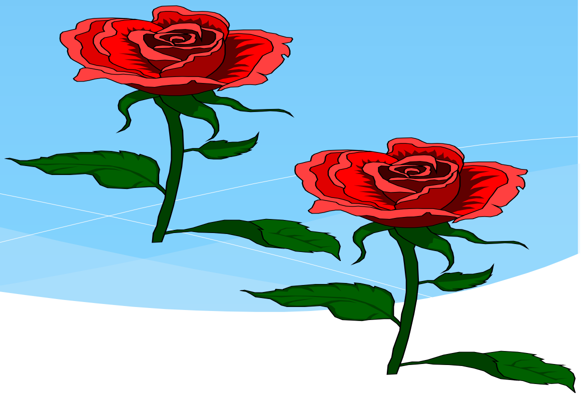


To ensure students consider a global perspective beyond domestic plants and issues, assigned “mystery” plants and plant products include international examples.

Each team must then identify the plant or plant product they are assigned, research various aspects and uses of the plant or plant product and create a presentation, including PowerPoint, for the entire class.

Students were offered extra credit for including tangible objects in their presentations; many teams prepare and serve edible dishes to share with the

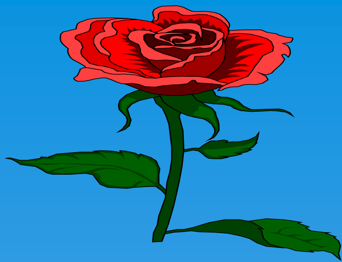
One key requirement for the “Know Your Plant Project” is that the instructor or teaching assistant of the course will not help in identifying the assigned mystery plant or plant product. Students are allowed to question faculty or students who are not directly linked with the course. Some mystery plants/plan products are seeds –student teams who receive seeds as their mystery product frequently choose to plant the seeds to try to identify the plants as it grows.

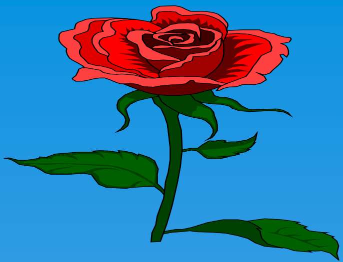


The "Know Your Plant Project" develops and measures presentation skills using a detailed rubric to evaluate presentations based on content, professional appearance, presentation skills and timely submission.

The project also fosters team work: The project is assigned early in the semester and motivates students to work together and interact regularly to successfully complete the assigned project.

Because the project requires students to interact with each other, students develop personal connections with others in the class and not just with those in their own teams. This is a particularly important element because students come to this class from various colleges and majors, rarely know each other and are not generally inclined to form personal associations.





Students are evaluated for their individual contributions towards the group activity by the instructor and through confidential peer-evaluations.

Peer evaluations are averaged and then included in calculating the final grade on the project.

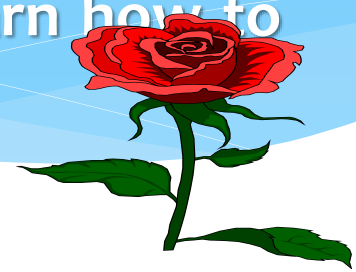
To ensure students are attentive during presentations, each team is required to contribute a list of questions to the instructor from their presentations. Questions are then selected by the instructor for inclusion on quizzes.

A reflective element is also included in the project. In the reflection students provide feedback to the instructor about their experiences in the team activity.

A vast majority of students indicate the project is a positive experience.

Students report that the project fosters interest and investment in a particular plant – that they engage in deeper research and learn much more about their assigned plant than what is required or expected for the team activity.

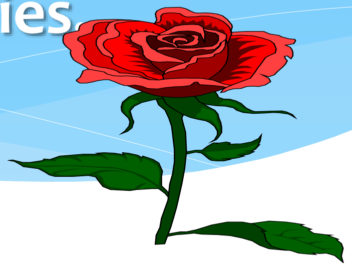
Many students also indicate that the project provides valuable lessons in teamwork, including cooperating and sharing responsibility with other team members. Finally students report that the project helps them learn how to find information and how to problem solve.



This "Know Your Plant Project" aroused student interest in the subject matter early in the semester and retained that interest throughout the semester.

The results of the project demonstrate that inquiry based hands-on experiences are instrumental in 1) helping students connect abstract ideas to the real world, 2) building personal connections between students, and 3) generating and maintaining interest in agriculture and plant sciences.

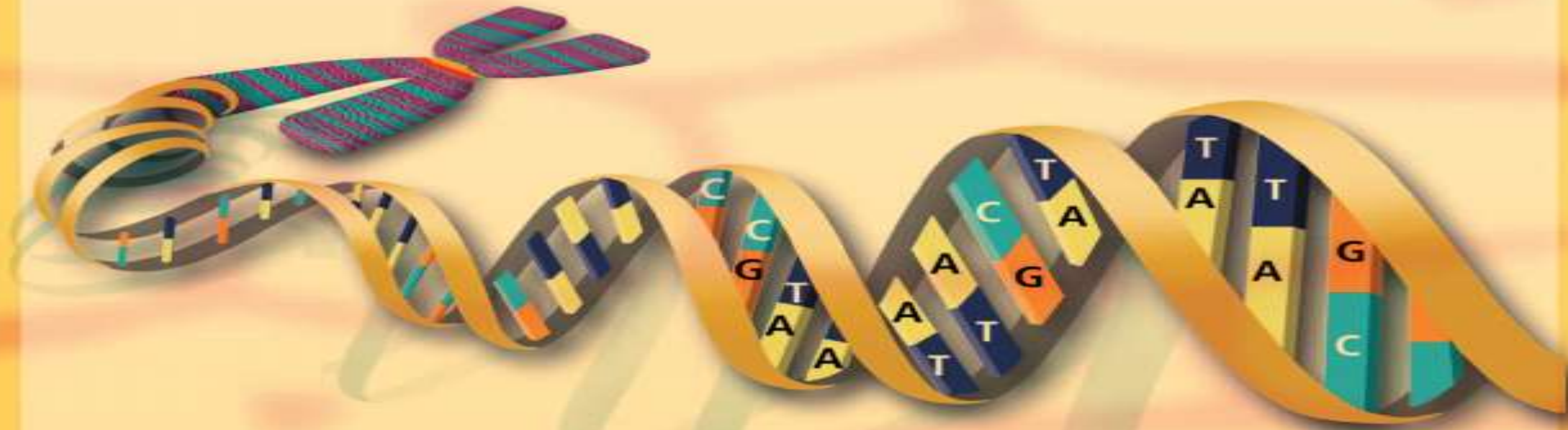
Through content-based inquiry and learning using the "Know Your Plant Project", students improve their teamwork and communication skills, as well as develop information literacy and problem solving strategies.



Yesterday, Today and Tomorrow

Agricultural Biotechnology

A Grade 6 – 8 Unit of Study



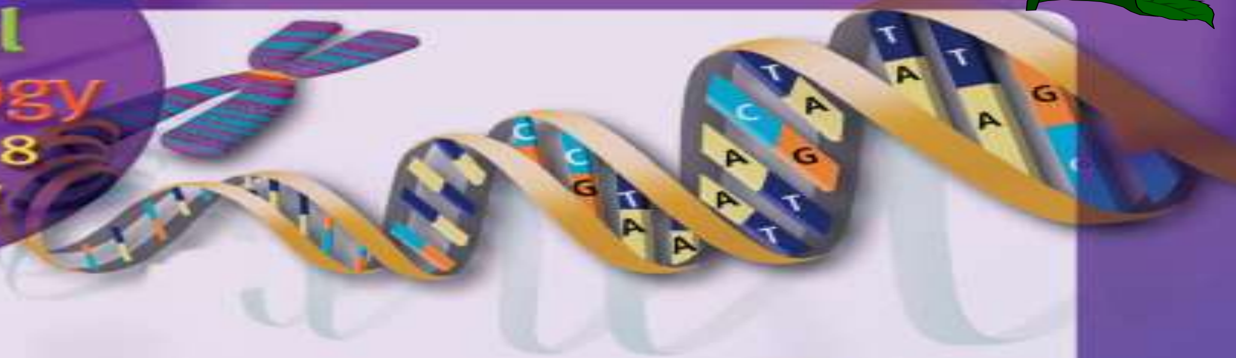
The Children's Museum
of Indianapolis

Table of Contents

Yesterday, Today and Tomorrow

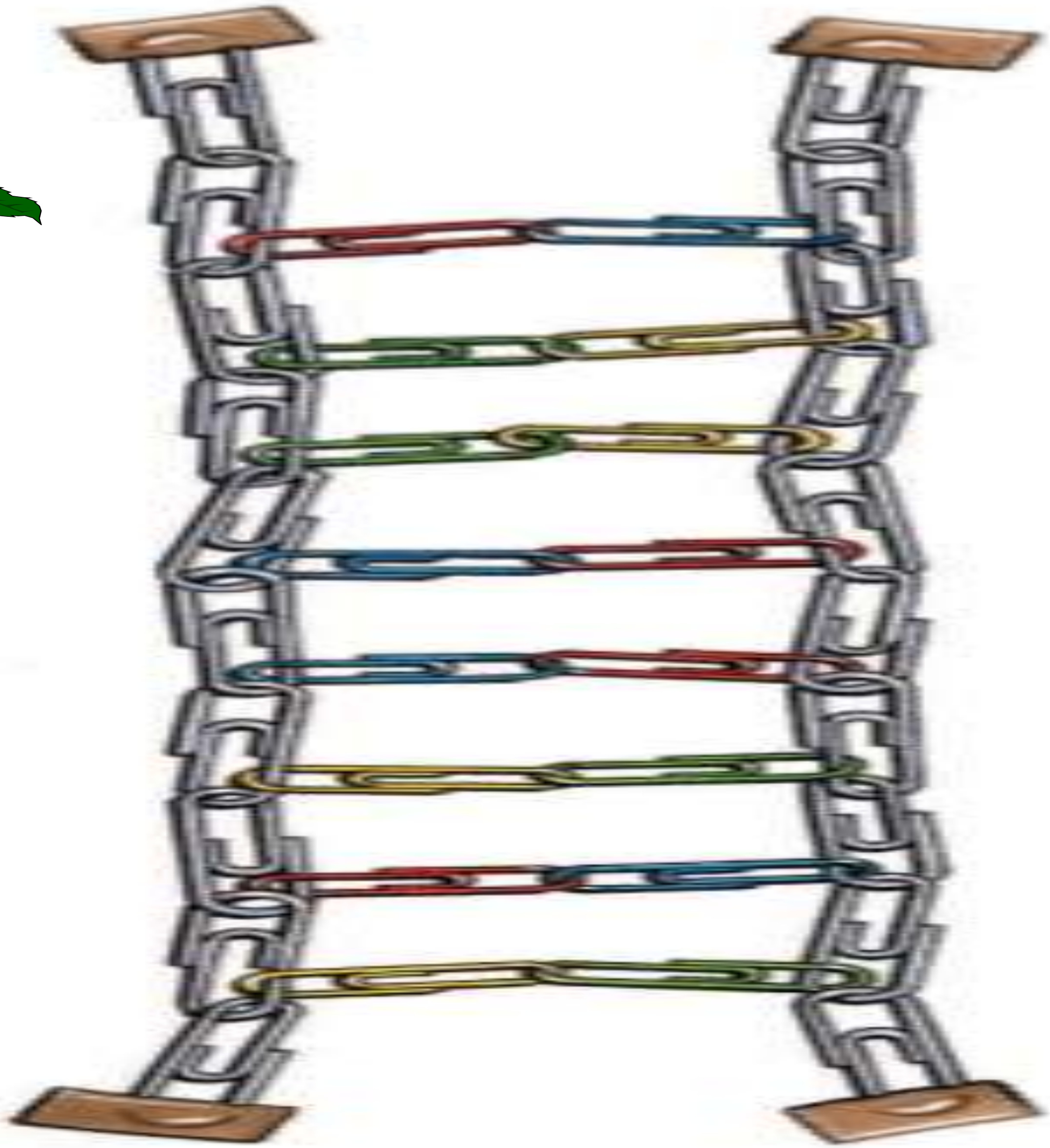
Agricultural Biotechnology

A Grades 6 – 8 Unit of Study



Model of an animal cell.

Use models or posters like these to enhance learning in the classroom.



After the DNA paper clip model is assembled, it should look like this.

Culminating Activity:
Agricultural Biotechnology of Tomorrow

A guided-inquiry project

There are many stages in implementing agricultural biotechnology. During the developmental stages, scientists must research, identify problems in agriculture, problem solve, propose solutions, follow safety guidelines, meet state and federal regulations, and identify the risks and benefits of implementing a biotechnology practice. In this experience, students will identify agricultural issues, devise solutions and create displays to share with the class. As they begin, students imagine the capabilities scientists may have in the near future with the use of advanced technology.

Indiana's Academic Standards

Science

Standard 1: The Nature of Science and Technology (6.1.8, 6.1.9, 7.1.3, 7.1.8, 7.1.9, 7.1.10, 8.1.4, 8.1.7, 8.1.8)

Standard 2: Scientific Thinking (6.2.7, 8.2.7)

Standard 4: The Living Environment (6.4.13, 7.4.9, 7.4.10, 8.4.8)

Social Studies

Standard 3: Geography (6.3.13, 6.3.14, 6.3.16, 6.4.10)

Objectives

Students will:

- Research existing agricultural biotechnology techniques.
- Identify common agricultural issues and create solutions to these issues by incorporating biotechnology.
- Identify controversial issues related to agricultural biotechnology.
- Discuss safety, regulation, environmental risks and benefits, nutrition, farming and farmers, and consumer factors involved when implementing biotechnology.
- List the pros and cons for implementing agricultural biotechnology techniques.
- Advertise or display an agricultural biotechnology problem and solution to the class.

Focus Questions

- What are some agricultural issues of today?
- What are the pros and cons of implementing agricultural biotechnology?
- What are possible controversial issues that are related to agricultural biotechnology?
- How does the implementation of agricultural biotechnology affect farming, farmers and consumers?
- What are the environmental risks and benefits of implementing agricultural biotechnology?
- Should the government regulate agricultural biotechnology? Why or why not?

You will need ...

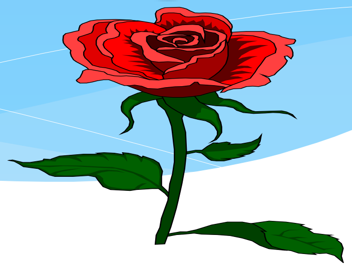
Time: As many days as desired, but at least four days in class. Time outside of class will also be needed.

Materials:

- **Ag Biotech of Tomorrow** handout (page 36)
- Resources for students to do research, library access and internet access
- Tables, signs or invitations for the Ag Biotech Fair

OVERTLY TEACHING CRITICAL THINKING AND INQUIRY-BASED LEARNING: A COMPARISON OF TWO UNDERGRADUATE BIOTECHNOLOGY CLASSES

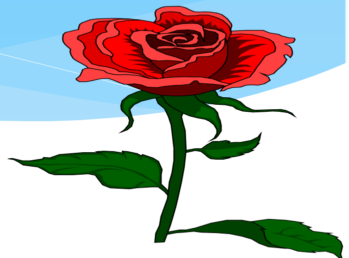
Some researchers have argued that science classrooms must move away from rote and passive applications of memorized concepts to the use of critical thinking skills as a primary component in facilitating learning. Yet few studies have examined the effect of overtly teaching for critical thinking on subsequent skill development.



The purpose of this study was to assess if overtly teaching for critical thinking, as a teaching method, contributed to explaining increases in critical thinking skill scores of undergraduate students enrolled in agricultural biotechnology. One group of students were taught components of critical thinking and then asked to use the newly learned skills in class.

A nonequivalent control group was instructed using the inquiry based teaching method. The data exhibited significance between groups giving evidence that overtly teaching for critical thinking improves students' critical thinking skills as opposed to using the inquiry-based teaching method.

Adding gender to the model did not significantly increase the explanation of variance in critical thinking skills. Also, a weak positive correlation was found between the total critical thinking skill score and the total critical thinking disposition score.



Purpose and Objectives

Thinking skills learned through inquiry based learning include "…identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations" (National Research Council, 1996, p. 23).

Although critical thinking skills are taught through inquiry-based instruction, would students improve their critical thinking skills if they were identified within context and overtly taught within class assignments?

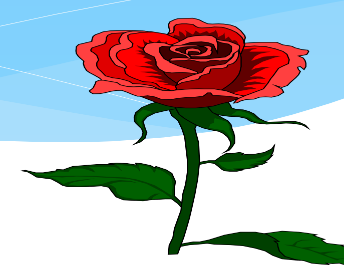
The purpose of this study was to assess the relationship between critical thinking skills and different instructional methods within the context of agricultural biotechnology. Specifically, the objectives of the study were to:

1. Determine selected demographic information of undergraduates enrolled in the courses AGR 2612 Seeds of Change and PLS 2003 Plants that Feed the World.
2. Determine undergraduate level of critical thinking skills and critical thinking dispositions and explore differences between the two groups.
3. Determine the relationship between overtly teaching critical thinking skills and selected demographics with the posttest critical thinking skills of participants.
4. Determine the relationship between critical thinking skills and critical thinking disposition

Recommendations

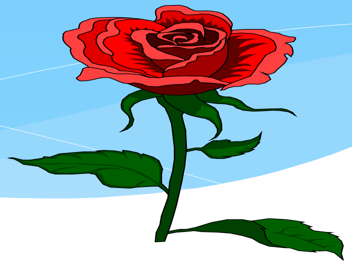
In this study, overtly teaching critical thinking skills within a specific knowledge domain did significantly facilitate the increase of total critical thinking skills scores with emphasis in the thinking skill evaluation (Huitt, 1998), more so than inquiry-based learning.

The authors caution the reader, as findings were limited due to the nature of nonrandomized samples. This study should be replicated to affirm the results and more research should be conducted to discover how to better increase students' use of analysis and inference thinking skills.



Moderate positive correlations were found throughout the constructs of critical thinking skills and critical thinking dispositions, except for the constructs cognitive maturity and evaluation. Why does this exist? Granted that the findings are similar to that of Facione and Facione (1997), the lower reliability coefficient of the cognitive maturity scale suggests more research is needed to be better able to measure critical thinking disposition.

Specific recommendations stemming from this study would therefore include more research into the measurement of these skill constructs, combined with further exploration of the role that overtly teaching for critical thinking plays in terms of student learning outcomes.



STEM Scale-Up Program
Menu for 2018-2019

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Curriculum for Agricultural Science Education (CASE) – Animal and Plant Biotechnology 2018-2019 STEM Scale-Up Program

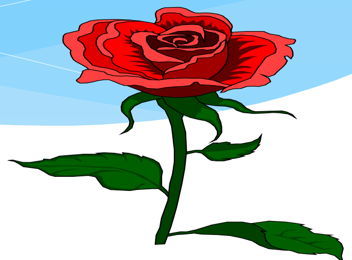
CASE utilizes science inquiry for lesson foundation and concepts are taught using activity-, project- and problem-base instructional strategies.
In addition to the curriculum aspect of CASE, the project ensures quality teaching by providing extensive professional development for teachers that leads to certification.

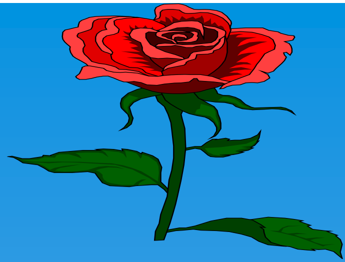
Program Objectives and Description

Students will maintain a research level Laboratory Notebook throughout the course documenting their experiences in the laboratory. Research and experimental design will be highlighted as students develop and conduct industry appropriate investigations. Students will develop and conduct a research project following the National FFA Agriscience Fair guidelines.

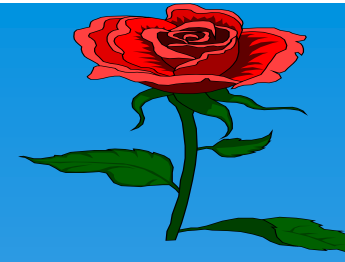
From background research through data collection and analysis, students will investigate a problem of their choice and conclude the project by reporting their results in the forms of a research paper and a research poster.

In addition, students will complete all of the laboratory experiments for Advanced Placement Biology – in addition to several others – all in an agricultural context.





Program Summary

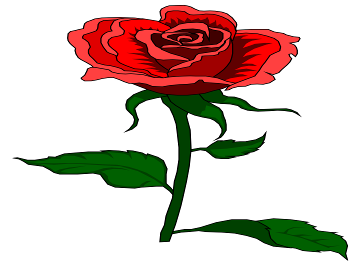


Animal and Plant Biotechnology, a specialization course in the CASE Program of Study, provides students with experiences in industry appropriate applications of biotechnology related to plant and animal agriculture.

Students will complete hands-on activities, projects, and problems designed to build content knowledge and technical skills in the field of biotechnology.

Students are expected to become proficient at biotechnological skills involving micropipetting, bacterial cultures and transformations, electrophoresis, and polymerase chain reaction.

Hindawi Publishing Corporation
Education Research International
Volume 2012, Article ID 536024, 8 pages
doi:10.1155/2012/536024



Research Article

Project-Based Learning to Promote Effective Learning in Biotechnology Courses

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Academic Editor: Annemie Desoete

With enrollment in the fields of science, technology, engineering, and mathematics (STEM) shrinking, teachers are faced with the problem of appealing to a new generation of students without sacrificing educational quality. Evidence has shown that this problem can be reduced with the use of a number of pedagogical strategies of which project-based learning (PBL) is one. PBL addresses the fundamental challenge of increasing students' motivation, their mastery of course material, and finding applications for what they have learned to apply in various situations. This study demonstrates the benefits of redesigning a standard lab-based molecular biology course to create a more effective learning environment. Using PBL, students who enrolled in Bio-251 at Harold Washington College in Chicago were given the responsibility of cloning a bacterial gene from one species into a new host species. They were then tasked with the expression and purification of the resulting protein for future research purposes at University of Illinois-Chicago, a leading 4-year research institute. With use of the PBL method, students showed improvement in the areas of self-confidence, lab technical skills, and interest in STEM-related fields and, most of all, the students showed a high level of performance and satisfaction.

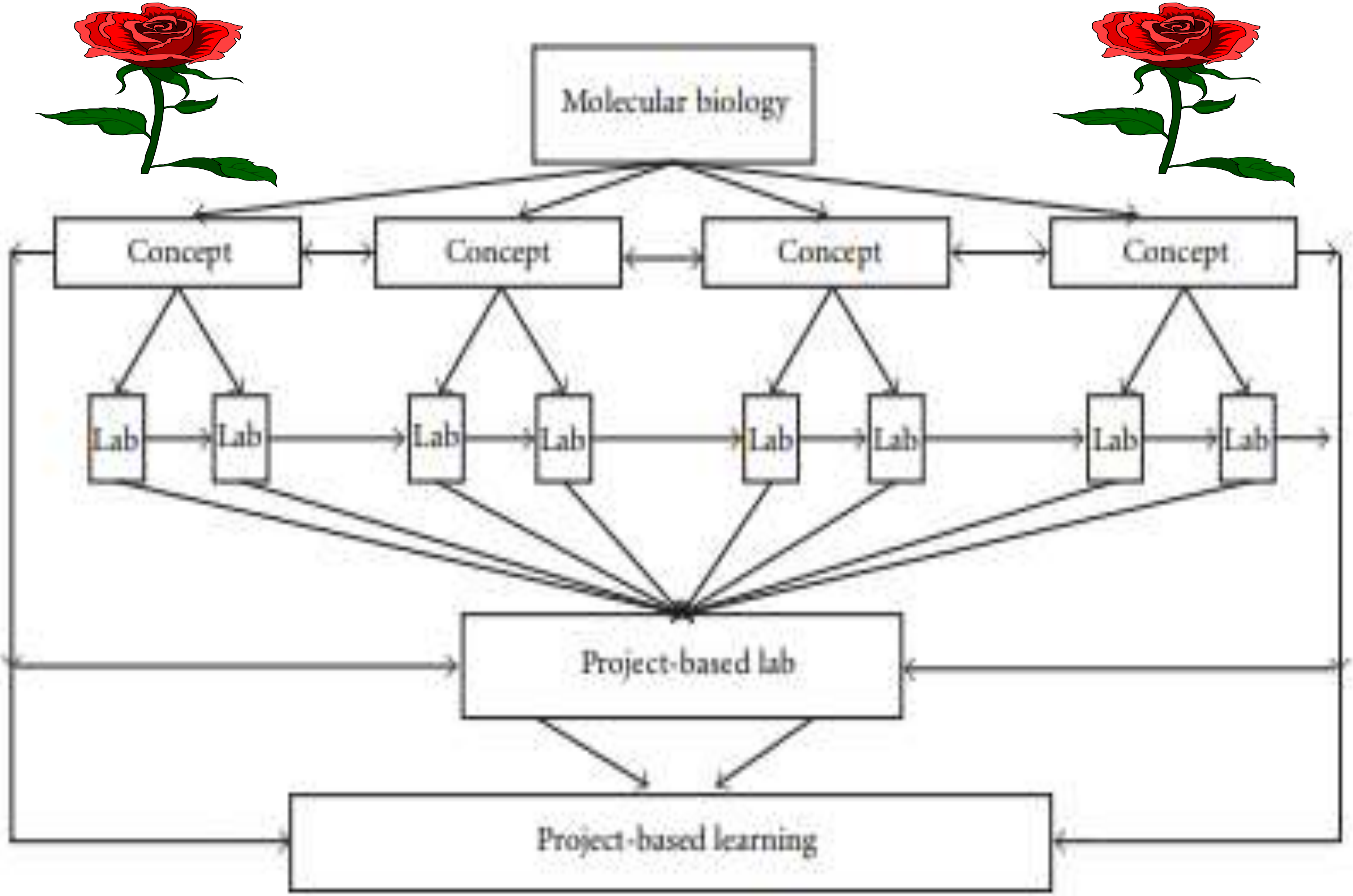


Figure 1: Concept map for project-based learning.

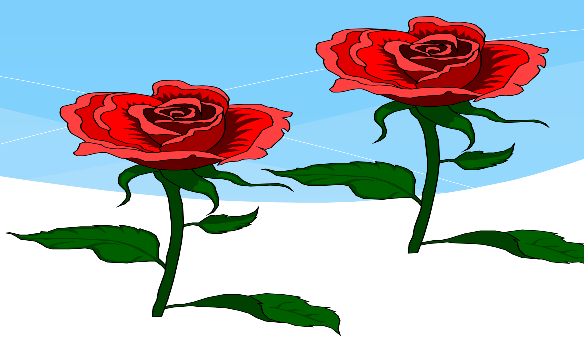
Discussion and Conclusion

Many educators would agree that the classic methods of teaching science is currently plagued by ineffective artifacts and thus is in dire need of modernization.
While the facts delivered by the standard methods seldom change, the audience does. Even though certain students in each class can learn from the current methods, the rest of the students are too often weeded out, regardless of their innate talents.
New methods of teaching are needed for the students of today, especially in STEM fields. The objective of promoting growth in the number of students enrolled in STEM programs is shifting from an advantage to a necessity in the modern world.

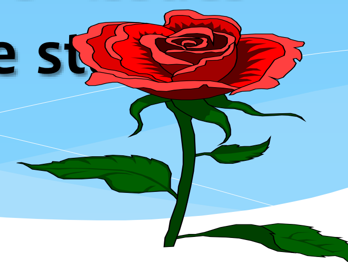
Project-Based Learning is a method in which students engage in intellectually challenging tasks that drive inquiry questions through gaining content knowledge and academic skills to solve complex problems and informatively defend their solution and outcomes.

At HWC, project-based learning enabled the Bio-251 students to practice real world lab methods currently used in biotechnology, to comprehend the process of scientific inquiry that is practiced by working scientists, and to gain knowledge and demonstrate evidence of achievement.

Learning research skills through practical experience is one of the main objectives of the project-based learning method, which has been supported by the NSF and the NRC .

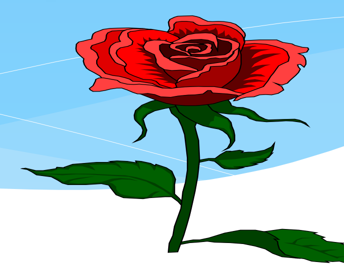


The individual experience of utilizing the laboratory stimulates increased excitement, knowledge, and confidence in performing applied scientific procedures. Important conceptual connections are made between critical thinking and practical applications through student learning on specifically designed projects.
Throughout the semester, the class developed a good rapport that allowed them to work through and troubleshoot labs together, effectively changing the instructor’s role from teacher to mentor.
The students consistently worked together to overcome the obstacles
encountered in class, many of which are issues encountered by professional scientists, as one st
stated



The overall mood and environment of this course were unlike anything I had previously experienced. At first, I was wary about taking a 5-hour course on Friday evenings, but when coupled with the casual structure and team emphasis, it felt more like getting together with friends to work on a hobby project than a molecular biology project.

The sessions were highly productive and when something did go wrong, we were able to call for a time-out to discuss, we were quick to diagnose, and there was never a shortage of volunteers to help keep things moving.



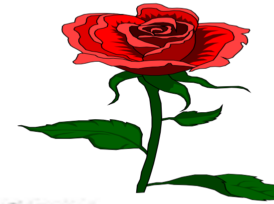
The team-oriented environment is further supported by the survey.
It is apparent that very few, if any, of these Bio-251 students will forget this experience. Students were able to understand the concepts presented to them, while at the same time contribute valuable data and insight for research at UIC and for the world of molecular biology. Furthermore, some of the students started seriously thinking about continuing their education beyond the associate degree level.

education sciences

MDPI

Article

The Impact of Innovative Teaching Approaches on Biotechnology Knowledge and Laboratory Experiences of Science Teachers



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Abstract: The current study presents an evaluation of the laboratory instructional tasks prepared based on innovative teaching approaches (research-inquiry, problem solving, project, argumentation and web-based interdisciplinary learning approaches) designed to enhance science teachers' biotechnology knowledge, awareness and laboratory experiences. The laboratory instructional tasks developed by the researchers aim to improve the laboratory experiences, as well as support the teaching of biotechnology through innovative teaching approaches. For this purpose, in-service training course titled Biotechnology Education Practices was conducted with the voluntary participation of science teachers (n = 17). The current study employed the embedded design. The quantitative part of the embedded design is designed as the single group pretest-posttest model and the qualitative part of it is designed as the case study. The data of the current study were collected through the Biotechnology Awareness Questionnaire, Biotechnology Evaluation Questions, The Laboratory Self-Evaluation form and worksheets. The results obtained from the analyses revealed that the instructional tasks conducted within the context of the Biotechnology Education Practices resulted in significant effects on the science teachers' biotechnology knowledge and awareness and that the innovative teaching approaches were effective in developing the science teachers' laboratory experiences. It would be useful to use laboratory instructional tasks enriched with innovative teaching approaches in teaching biotechnology subjects.

Keywords: biotechnology; innovative teaching approaches; laboratory experience; science teacher; science education

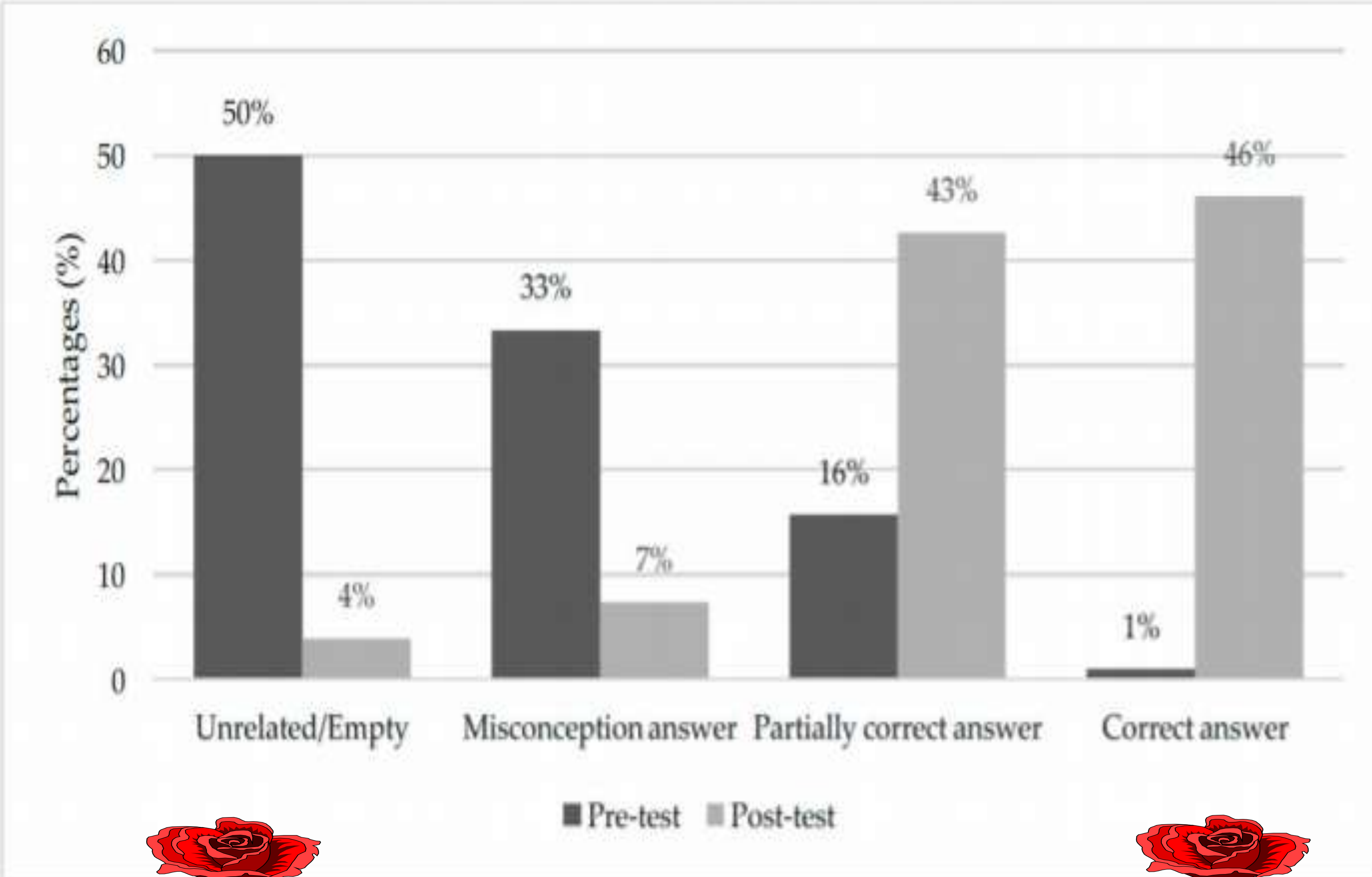


Figure 1. Result of Biotechnology Evaluation Questions.

Table 7. Teaching approaches used in instructional tasks and categories.

Teaching Approach Used in Tasks/Categories	Readiness	Research Design	Practices	Evaluation
Research-inquiry based learning	Pre-inquiry (wondering)	Hypothesis, Identifying variables	Experiment design	Organizing the data, Result and evaluation
Project based learning	Motivation (wondering/connecting)	Design and planning, Organizing according to standards	Activities/creating a generic framework on experiment	Evaluation and presenting
Problem based learning	Identifying the problem	Planning for the solution, Developing solution	Experimental process	Evaluation
Argumentation based learning	Claim	Data/reason, Supporting and corrupting evidence	Experimental process	Result
Web based-interdisciplinary learning	Problem/explanation	Variables and mathematical calculation	Experimental process	Usage of images Biology and computer science

5. Conclusions

As a result, the biotechnology instructional tasks prepared on the basis of innovative teaching approaches were found to be effective in enhancing the science teachers' biotechnology knowledge, awareness and laboratory experiences. This study is limited to the developed laboratory tasks and the study group.

In light of the findings of the current study, the following suggestions can be made:

- Both theoretical and experimental information should be given to science teachers about the teaching of issues related biotechnology and while planning how to this, innovative teaching approaches should be taken into consideration.
- It is suggested that science teachers be supported by in-service training, seminars, etc. related to biotechnology subjects and to increase the laboratory practices of science teachers and students.
- The current science teacher training course is limited to the teaching of biotechnology subjects. It is suggested that instructional tasks which allow integration of the laboratory-based and innovative learning approaches are included in the science teacher training programs and included in the science curricula.
- Aside from the instructional tasks used in the current study, activities related to different contemporary issues of biotechnology and based on different innovative teaching approaches can be designed and their contribution to teacher training can be investigated.

Journal of Agricultural Education, 56(4), 169 -181. doi: 10.5032/jae.2015.04170

The Infusion of Inquiry-based Learning into School-based Agricultural Education: A Review of Literature

Trent Wells[1], Jennifer Matthews[2], Lawrence Caudle[3], Casey Lunceford[4], Brian Clement[5], and Ryan Anderson[6]

Abstract

Demands for increases in student achievement have led education professionals to incorporate various and rigorous teaching strategies into classrooms across the United States. Within school-based agricultural education (SBAE), agriculture teachers have responded to these challenges quite well. SBAE incorporates a wide variety of teaching and learning strategies, theories, and ideas into its conceptual framework. One such teaching and learning strategy is referred to as inquiry-based learning, commonly known in SBAE as problem-based learning. This method emphasizes cognitive development, critical thinking, and intellectual growth in students. The purpose of this study was to develop an understanding of the emergence and current utilization of inquiry-based learning in SBAE. We found that inquiry-based learning has been a long-standing staple in SBAE, particularly in terms of increasing the achievement of agricultural students. As a result, a model of the use of inquiry-based learning in SBAE programs was developed. Recommendations, discussion, and implications for research and classroom practice were included in this study.

Keywords: inquiry-based learning; school-based agricultural education; teaching methodology

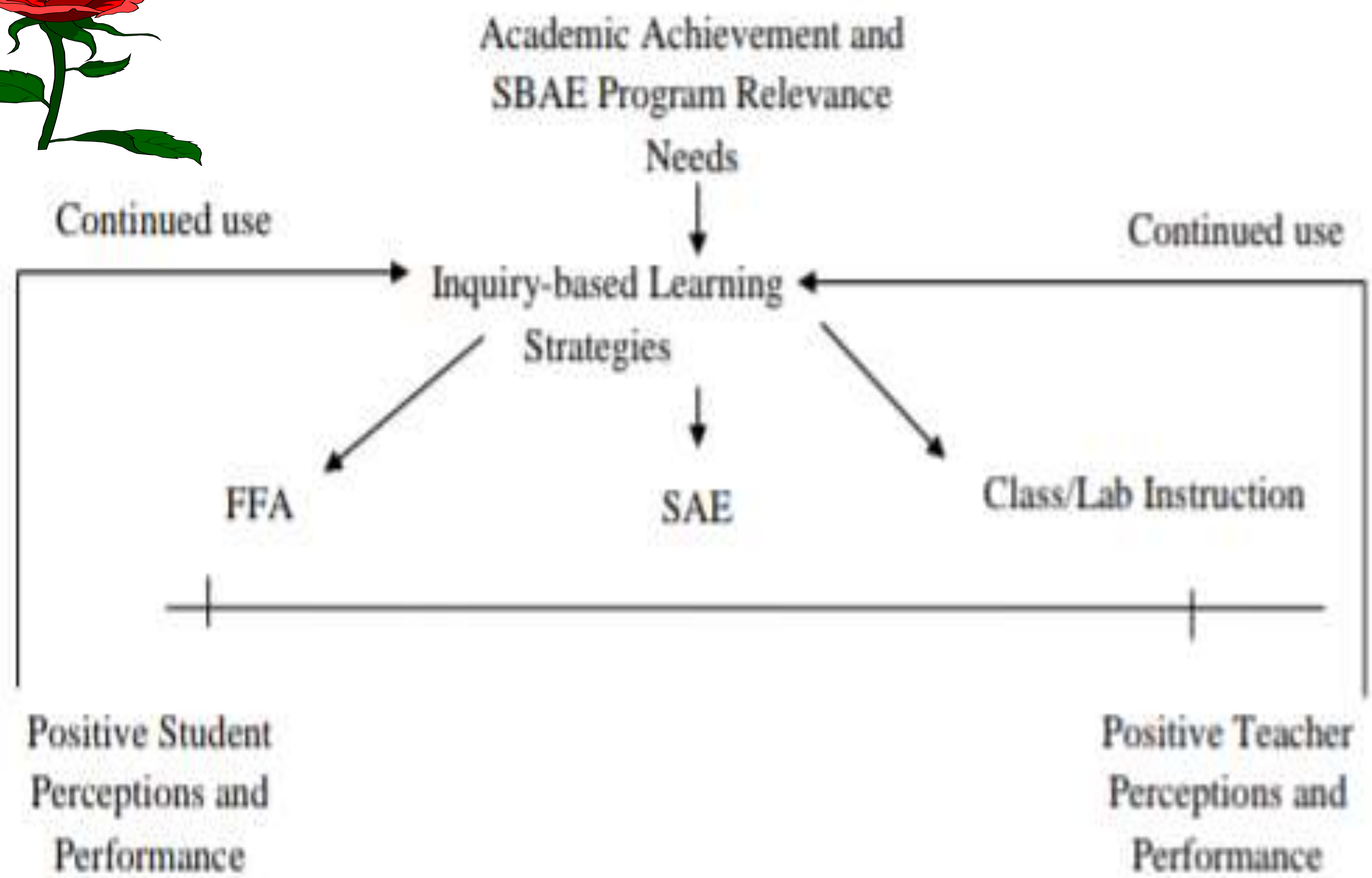


Figure 1. Inquiry-based learning in the comprehensive SBAE program.

Purpose of this Study & Objectives

The purpose of this study was to describe the historical use of inquiry-based learning in the field of SBAE. This purpose was supported by the following objectives:

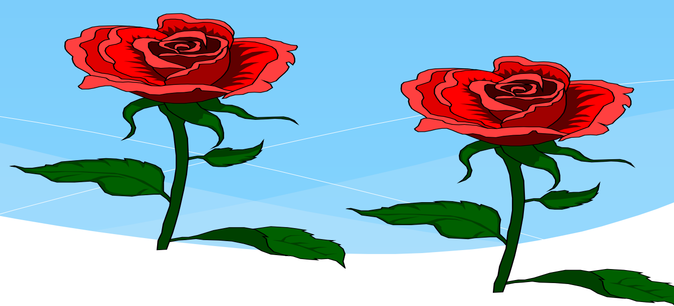
1) Describe the role that inquiry-based learning has historically played in SBAE.

2) Describe the incorporation of inquiry-based learning into the three-circle model of SBAE.

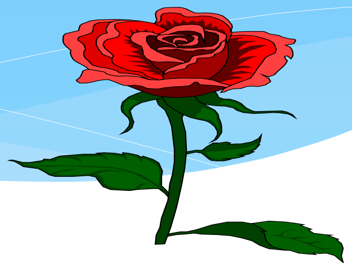
Recommendations and Possibilities for Future Research and Practice

The current study illustrated previous instances of the use of inquiry-based learning in SBAE programs. However, additional possibilities remain. As demonstrated by Thoron and Myers (2011), inquiry-based learning holds much promise for increasing students' retention of content knowledge while increasing their overall academic achievement. Such work can highlight the potential value of SBAE for overall student development. However, little empirical evidence has been added to the agricultural education literature base since the prior study. Additional research should follow suit and work to establish a more solid body of knowledge regarding inquiry-based learning in SBAE. New literature should also emphasize methods that specialized teaching strategies (such as inquiry-based learning) can utilize to increase students' retention of both academic and technical content knowledge, as described by Doerfert (2011). Such methods could hold much promise for furthering the utility and value of SBAE in modern school setting [illegible] al., 2006).

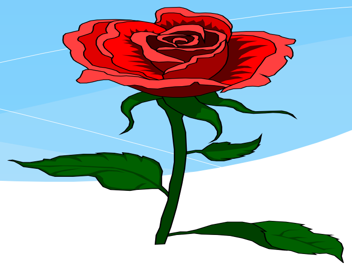
We recognize that inquiry-based learning can be integrated into SBAE in multiple ways and content areas, such as agricultural mechanics, horticulture, animal science, biotechnology, and more. As a result, perhaps additional research should be conducted to analyze current agriculture teachers' use of inquiry-based learning within their curricula, such as the content analysis of lesson plans. Washburn and Myers (2010) found that agriculture teachers believed that science integration and inquiry-based teaching were important to SBAE as an entity; however, this population also indicated limited use of inquiry-based learning within classrooms. Perhaps this is tied to selected barriers regarding science integration, as described by past researchers (Myers & Washburn, 2007; Thompson, 1998; Washburn & Myers, 2010). These barriers included "insufficient planning time, lack of requisite materials, and insufficient funding" (Washburn & Myers, 2010, p. 89). Further research should look to address this potential correlation between such factors and the adoption of inquiry-based learning in SBAE.



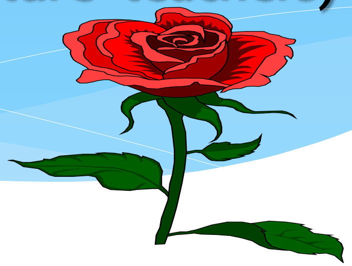
The lack of literature regarding the use of inquiry-based learning in the FFA and SAE components of SBAE programs is alarming to us. While other researchers (Roberts, 2006; Rogers, 1969) have emphasized how the experiential model of learning with SBAE is ripe for the use of problem-based learning and inquiry-based learning, the quest for literature pertaining to the process's use within the SAE and FFA elements was quite fruitless. However, this does not mean that the process is not occurring with SBAE programs across the nation. On the contrary, perhaps there exists a dearth of productive research in these areas. Perhaps studies should be launched to address perceptual, adoption, and incorporation of inquiry-based learning in all aspects of comprehensive SBAE programs.



Regarding the practice of integrating inquiry-based learning, agriculture teachers should continuously look for methods to integrate this historic practice into their coursework (Parr &Edwards, 2004; Phipps et al., 2008; Washburn & Myers, 2010). As this practice is more commonly known as problem-based learning within the SBAE community (Parr & Edwards, 2004), many teachers currently utilize this method effectively (Phipps et al., 2008). Interestingly, as science curricula are often taught through an inquiry-based approach, and as science is inherently tied within agricultural coursework, many agriculture teachers report that pressure to practice science integration has come from a top-down approach (e.g., state mandates, administrator requests, etc.) (Washburn & Myers, 2010). Perhaps teachers feel more inclined to teach through inquiry-based learning only when science integration pressures are a factor. Agriculture teacher in-service meetings may serve as a valuable medium for opening the dialogue concerning these issues.



As developing and instilling the practice of effective teaching is achieved at the pre-service level (Phipps et al., 2008), teacher education coursework should include instruction in inquirybased learning (Washburn & Myers, 2010). Further, this coursework should emphasize the use of such instruction in all facets of the SBAE model (i.e., classroom/laboratory instruction, SAE, and FFA). Phipps et al. (2008) and Thoron and Myers (2011) described how this method of teaching can positively influence students' classroom performance, while Wells and Retallick (2013) found that significant potential for academic instruction exists within the realm of SAE. As SAE serves as the natural outlet of classroom/laboratory-based teaching and learning (Ramsey & Edwards, 2012), inquiry-based instruction may hold significant possibilities for increasing student understanding of real-world phenomena that may result in higher overall program experience quality. Wells, Perry, Anderson, Shultz, and Paulsen (2013) found that experiences at the secondary level can influence post-secondary educational pursuits. Thus, agriculture teachers should heed these calls to improve professional practice, as the eventual fate of the discipline (e.g., the recruitment and retention of future teachers) depends upon it.



Introducing Phytochemical Testing of *Sandoricum koetjape* Merr. Through Inquiry- Based Learning

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Keywords: inquiry, phytochemical, *Sandoricum koetjape* Merr.

Abstract: Phytochemical testing of natural products is one of the interesting topics in the chemistry research. So, it's necessary to introduce for Senior High School students. Currently the phytochemical testing laboratory (lab) manual of *Sandoricum koetjape* Merr., has been successfully performed, focussed on the secondary metabolites findings of flavonoids and alkaloids. The experiment method of the verified-lab manual can be implemented in a practicum-based inquiry learning activities. Experiment of lab activities increased students understanding and knowledge about phytochemical test of secondary metabolites of *Sandoricum koetjape* Merr., which were confirmed by all students/groups achieved hypothesis successfully, a highest post-lab assignment score and students ability to conclude their experiment.

Table 1. Groups achievement to Hyphotesis

Group	Phytochemical test		Hypothesis	
	Alkaloids	Flavonoid	Reached	unreached
1	(+)	(+)	V	
2	(+)	(+)	V	
3	(+)	(+)	V	
4	(+)	(+)	V	
5	(+)	(+)	V	
6	(+)	(+)	V	

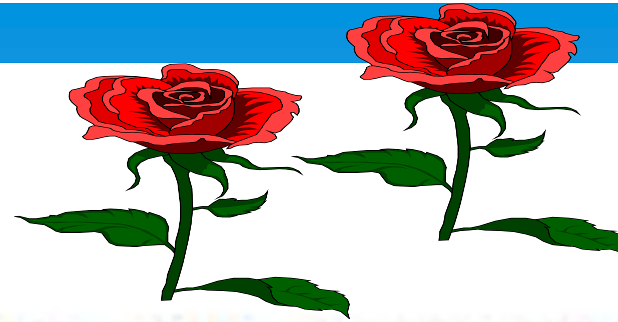
All of students through their group were able to reach hypothesis based on experiment goals. Each group observed that when sample was treated by flavonoids test formed yellow-orange in the amyl reagent solution which confirmed a positive test to flavonoids, while when it was treated by Dragendorff reagent, formed the orange precipitation spot, which confirmed a positive test to alkaloids. According to this observation and results, indicated that students had succeed do experiment.

In Table 2, we can see understanding students through pre and post-lab assignment.

Table 2. Comparison pre/post – lab assignment score

Indicator	Score assignment (%)		Comparison
	Pre-lab	Post-lab	
Definition of secondary metabolites	68.75	100	Increaced
Kinds of secondary metabolites	37.50	87.50	Increased
Structure of alkaloids and flavonoids	31.25	87.50	Increased
Reagents for phytochemical test of alkaloid and flavonoids	25.00	100	Increased
How to identify secondary	18.75	100	Increased

4 CONCLUSIONS



This experiment by lab activities had increased students understanding and knowledge about phytochemical test of secondary metabolites of *Sandoricum koetjape* Merr. All students reached hyphotesis of experiment, those are a positive (+) test to alkaloids and a positive (+) test to flavonoids. Post-lab assignment score (95%) increased compare with pre-lab assignment score (36.25%). Finally, students were able to conclude how to identify secondary metabolites of *Sandoricum koetjape* Merr. and its results.

Inquiry-Based Biotechnology Education For Kent Intermediate School District Early College Program

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Abstract

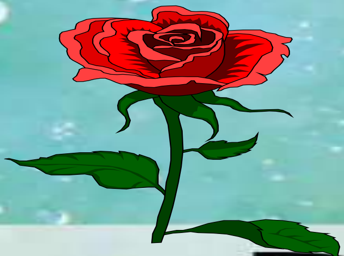
Growth in the field of biotechnology, combined with the ability to access information instantaneously, requires a new model of science education that will nurture deeper understanding and higher order thinking to develop a scientifically literate population. Inquiry based learning is a student-centered model built on the theoretical framework of constructivism, which allows students to learn in a way that reflects how scientists come to understand the natural world.

This project aimed to address the need for an inquiry-based biotechnology curriculum in a local Early College program by developing, piloting, revising, and implementing an inquiry-based biotechnology unit while simultaneously evaluating the impact of this curriculum on content knowledge and students' motivation toward science learning.

Results revealed that student assignment scores were consistent with a B- average and performance on the final presentation was consistent with an A- average, while content knowledge increased approximately 9 to 19 percentage points comparing pretest and posttest.

Overall, using the Student Motivation Toward Science Learning survey, we did not see any measurable changes in students' motivation toward science learning except for a slight decrease in self-efficacy, which could be reasonably expected given student discomfort experiencing both a novel curriculum and pedagogy.

Qualitative student feedback, however, was positive regarding independence, accountability, and group discussion and students displayed a high level of enjoyment with the hands-on activities. Thus, this project resulted in a sample inquiry-based biotechnology curriculum unit that produced reasonable gains in content knowledge, and with further work on the affective components important to cognitive growth, displays potential for even larger content knowledge gains and increased student motivation toward science learning.



PROFILES

Professional Reflection Oriented Focus on Inquiry-based Learning and Education through Science

Bolte, C., Rauch, F. (Eds.):

Enhancing Inquiry-based Science Education and Teachers' Continuous Professional Development in Europe: Insights and Reflections on the PROFILES Project and other Projects funded by the European Commission

Book of invited presenters of the
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http://www.profiles-project.eu

Preface

Welcome to another one – the 3rd – Book of PROFILES. This book includes contributions of colleagues involved in innovative projects who want to share their experiences on how they try to enhance scientific literacy in their countries. Besides this, four "special guests" have been invited to present their reflections on how to improve science education, focusing on both fields of education: school science practice and science teacher education. Alicia C. Alonzo from Michigan University (USA) offers insights into the "Role of Curiosity in Science Teacher Professionalism and Evidence-based Practice". In contrast, David F. Treagust from Curtin University in Perth (Australia) focuses on "Inquiry Learning and other Evidence-based Practice". Meinert A. Meyer from University of Hamburg (Germany) and Per-Olof Wickman from Stockholm University (Sweden) discuss the terms "Bildung and Education through Science" from two theoretically based viewpoints: a more general viewpoint of pedagogy (M. A. Meyer) and the perspective of science education (P.-O. Wickman).
This book includes 69 contributions presented at the "2nd International PROFILES Conference on Enhancing Scientific Literacy" (Berlin, Germany, 25th–27th August 2014). The contributions are divided into six sections, which correspond to the four formats of presentations during the conference.

The first section contains the keynote lectures (mentioned above), followed by the second section that includes the reflections of the PROFILES work package leaders on the work carried out in the project so far. In the third section, PROFILES partners provide glimpses into the workshops they will offer at the conference. Summaries of insights gained within the project, which will be presented during the Interactive Poster Session, can be found in the fourth section of the book. A very special event at this conference is the "Fair of Innovative Science Education Practice". Here, colleagues of different projects funded by the European Commission can present their work and insights into their project activities. In addition, PROFILES partners and especially the partners' science teachers who have been actively involved in the PROFILES Continuous Professional Development Programme can use this opportunity to introduce "modules for science teaching and learning", which they adapted or developed and afterwards implemented in their science classes within the PROFILES project.

The Science Education Fair contributions by PROFILES teachers as well as the presentations of colleagues of other projects funded by the EC in the FP6 and FP7 programme are published in the fifth and sixth section of this book.

With this book of invited presentations, the PROFILES Consortium tries to offer a comprehensive overview of the activities and experiences of all PROFILES partners as well as colleagues from other science education projects in Europe who followed our invitation to present their contributions at the conference.

We would like to thank all authors and presenters for their contributions and dedicated work. Furthermore, we want to thank Jack Holbrook for his supporting feedback to most of the contributions of this book, Mira Dulle and Marlies Strobl for all their efforts in the editorial work, and the team at Freie Universität Berlin – especially Sabine Streller and Konstanze Scheurer – for organizing the "2nd International PROFILES Conference on Enhancing Scientific Literacy" in Berlin and hosting all of the attendees. Only through the support and cooperation of all partners, colleagues and participants it was possible to create a forum which will become – as we both, Franz Rauch and Claus Bolte, are convinced – a successful and fruitful event and starting point for increasing Scientific Literacy in Europe and beyond.

We hope you will enjoy this book and find a lot of interesting insights into science education practice.

Claus Bolte – Freie Universität Berlin, Germany

Franz Rauch – Alpen-Adria-Universität Klagenfurt, Austria

INQUIRY EDUCATION IN BOTANY – A WAY TO COPE WITH PLANT BLINDNESS?

RYPLOVÁ Renata

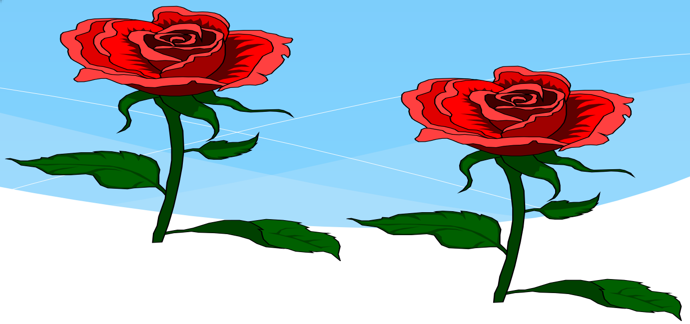
Abstract

Humans ignorance of the plants in our surroundings, called as „plant blindness“ is a serious environmental problem of human society. As one of the reasons of plant blindness the low attractiveness of botany learning at school is considered. This contribution brings the results of the survey testing the impact of inquiry education on the attractiveness of botany education at Czech schools. The results indicate, that inquiry approach, especially in combination with outdoor education and supported by the use of modern technology can attract the students to botany.

Inquiry based science education (IBSE) is internationally known as didactic approach attracting the students to the study of the nature (European Commission, 2007).

Therefore there are presumptions, that the use of inquiry approach in teaching botany could enhance the attractiveness of the plants for our young generation. From this reason we have conducted a survey testing the suitability of IBSE to enhance students' interest in plants and their role in human's environment.

The goal of this survey was to find answers on two research questions: 1. Can IBSE enhance the attractiveness of plants for the students? 2. How to make inquiry based botany education more attractive for students?



METHODOLOGY

Inquiry units used in the survey

For the investigation of an impact of inquiry approach on students' attitudes to plants three different inquiry units related to the three different topics of plant physiology were used and applied at Czech basic and secondary schools:

1. „Why do spices smell? " Inquiry laboratory unit according to the rules of guided inquiry education, focussed on secondary plants products, applied at three Czech secondary schools, 2nd grade students.
2. „Interview with a tree" Inquiry unit focussed on environmental role of trees, supported by interactive white board and including hands on activities aimed to volatile organic compounds applied at three Czech basic schools, 7th grade student.
3. „Why is a shadow under a tree cooler than a shadow under an umbrella?" Inquiry outdoor unit focussed on plant water metabolism, using modern measuring devices during inquiry experiments, applied at three Czech secondary schools, 2nd grade students.

The duration of each unit was 90 minutes. The frame of all three inquiry units was the same:

1. Motivation followed by inquiry question
2. Constructing of the hypothesis under the guidance of the teacher
3. Experimental (hands-on) activity to prove the hypothesis
4. Formulating and presenting conclusions by students

5. Discussion on the results with the peers and teacher
6. Final overview made by teacher

RESULTS AND DISCUSSION

According to the results of pre-tests, 88 % of the respondents prefer animals to plants. This finding is in agreement with some foreign studies (Balas & Momsen, 2014, Patrick & Tunnicliffe, 2011).

For the students of focus as well as control group, botany education was less attractive (Median = 2, Fig.1). The importance of plants for our environment in pre-test was considered as less to average important (Median = 2 and 3, Fig.2). No significant differences were discovered among the both tested groups in pre-.test for attractiveness as well as importance of plants according to the Kruskal – Wallis test, ($p = 0.05$). In post-test significant differences among the tested groups were discovered ($p < 0.01$).

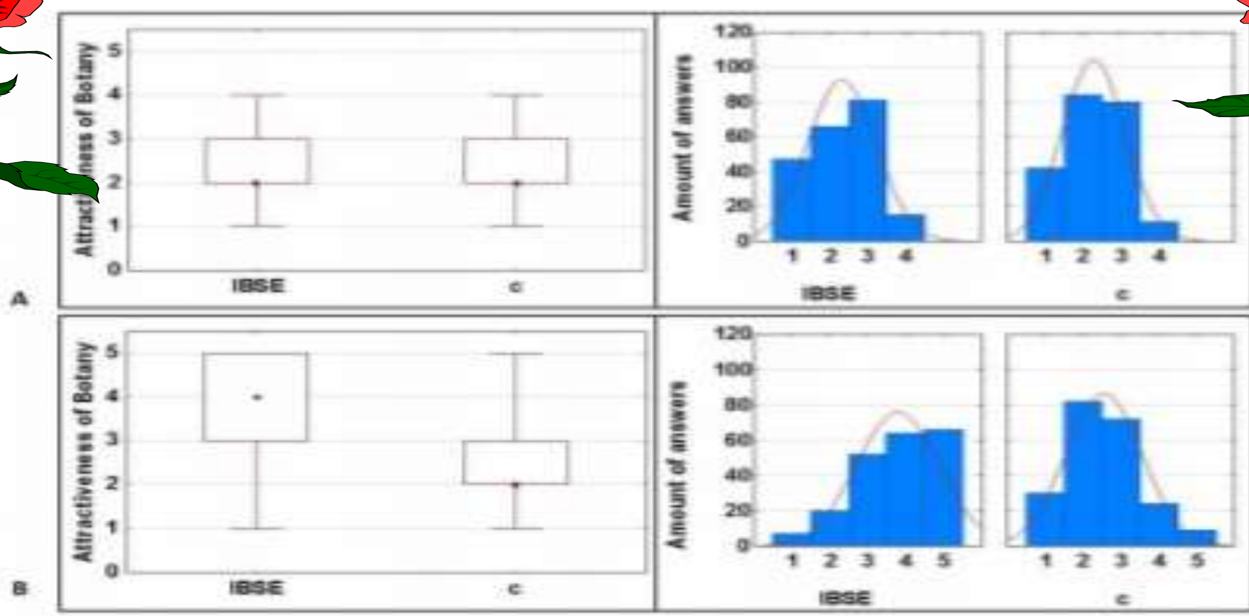


Fig.1 Students' assessment of attractiveness of botany learning and frequency of individual rating among the respondents (Likert type scale, grade 1= plants are boring, grade 5= plants are amazing) in pre-test (A) and post-test (B), n= 426. Small squares represent median values, boxes 25%-75% values, line segments min. – max. values. IBSE = respondents taught by inquiry approach, c = respondents taught by teacher centred approach.

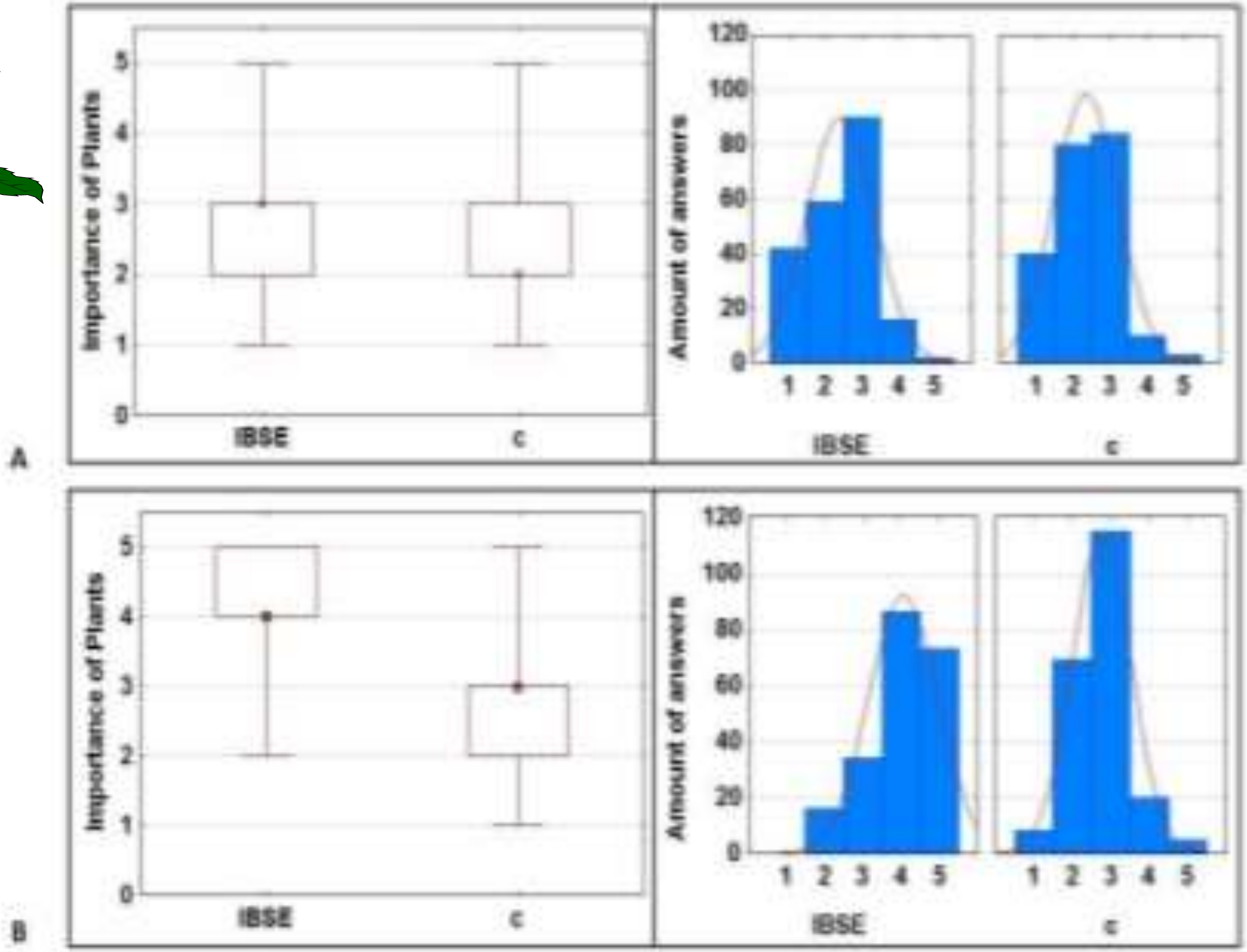
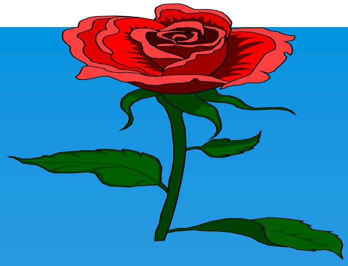


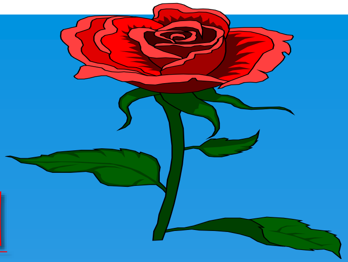
Fig.2 Students' assessment of importance of plants and frequency of individual rating among the respondents (Likert type scale, grade 1= plants are unimportant, grade 5= plants are very important) in pre-test (A) and post-test (B), n= 426. Small squares represent median values, boxes 25%-75% values, line segments min. – max. values. IBSE = respondents taught by inquiry approach, c = respondents taught by teacher centred approach.

Tab. 1 Factors of the attractiveness of learning as assessed by students taking part in different types of inquiry units. The values mean amount of students (in %) considering each factor as the most interesting during absolved education.

Attracting factors	Inquiry unit in laboratory	Inquiry unit+ IWB	Inquiry outdoorunit + technology
Working with technology	0 %	53 %	49 %
Working outside	0 %	0 %	34 %
Making experiments	52 %	36 %	15 %
Discussing the results with the peers	8 %	7 %	1 %
Other	4 %	0 %	0 %
No answer/ I do not know/ Nothing	36 %	4 %	1 %

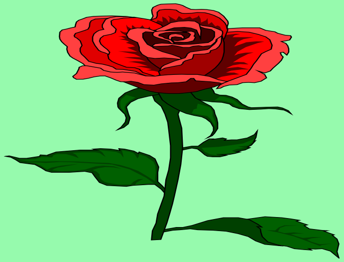


CONCLUSSION



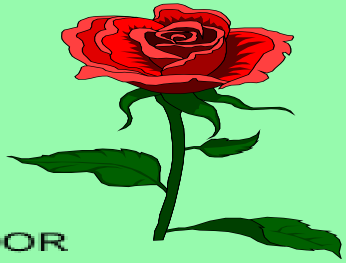
Based on the results of this survey we can conclude, that inquiry approach enhance attractiveness of the plants for the students and improve understanding of the significance of plants in our environment. To improve the attractiveness of botany learning to students and by this way, to cope with plant blindness of young generation, inquiry approach in combination with outdoor education and use of modern technical devices is recommended. The survey discovered a big lack of knowledge of 13 – 16 years old Czech students in the field of physiological role of plants in our environment. In this direction further research is recommended.

A MODEL TO IMPLEMENT A STEM CURRICULUM IN PLANT BIOTECHNOLOGY AT THE SECONDARY SCHOOL LEVEL



By

WENDY VIDOR



A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2017

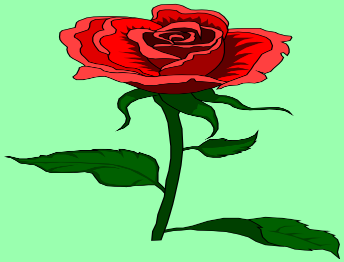
Abstract of Dissertation Presented to the Graduate School
of the University of Florida
Requirements for the Degree of Doctor of Philosophy

A MODEL TO IMPLEMENT A STEM CURRICULUM IN PLANT BIOTECHNOLOGY AT THE SECONDARY SCHOOL LEVEL

By

Wendy Vidor

December 2017



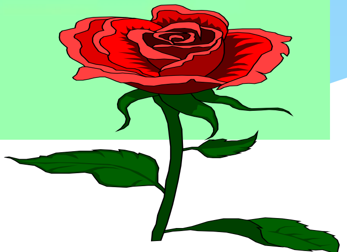
Chair: Michael E. Kane
Major: Horticultural Sciences

Agricultural biotechnology encompasses diverse scientific technologies and tools to improve plants, animals and microorganisms and includes techniques to make or develop organisms for specific agricultural uses. Biotechnology training and curricula are underrepresented in the classroom. The creation of new career paths incorporating STEM and biotechnology in secondary classrooms will require teachers to be trained and curricula to be written. The emphasis in Florida's career and technical education programs is to prepare students for STEM based occupations that are important to Florida's economic development in plant biotechnology. The purpose of this descriptive research study was to determine and alleviate barriers in teaching and integrating biotechnology in Florida. A survey was completed to determine teacher current barriers in Florida agriculture biotechnology teachers and subsequently develop effective teaching modules.

A major finding in the study was the agriculture teachers had concerns about teaching biotechnology including pre-service and in-service training, equipment, lack of instructional materials, and time constraints. A series of three comprehensive plant biotechnology teaching modules, meant to overcome these barriers, were evaluated by

agriculture teachers in a workshop experience. Teacher training modules were developed and assessed for effectiveness in the classroom. An evaluation revealed a significant content knowledge gain in posttest score compared to the pre-test for teachers after completing the teaching modules during the training. In a follow-up workshop, a plant biotechnology caladium shoot culture teaching module was used to determine the effectiveness of classroom flipping instruction on content knowledge gain of teachers using a pretest and posttest. The results indicated there was no significant effect of flipping on teacher content knowledge gain, but the teachers had positive views of the interactive flipped model for individualizing learning and increasing engagement in biotechnology content. These results were limited to the extent that instruction was limited to a small group of teachers due to size of the teaching facility.

Teacher's integration of biotechnology curricula and instructional approaches is dependent on teacher knowledge and self-efficacy of the subject. The results presented in this study are important for designing future biotechnology training workshops and effective plant biotechnology curricula.



Marina Casanoves de la Hoz

Biotechnology literacy of future teachers: A new educational approach

DOCTORAL THESIS

Supervised by Dr. Ángel-Pio González Soto

and Dr. Maria Teresa Novo Molinero

Pedagogy Department

Universitat Rovira i Virgili

Tarragona

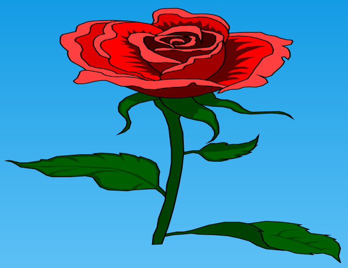
2015

ABSTRACT

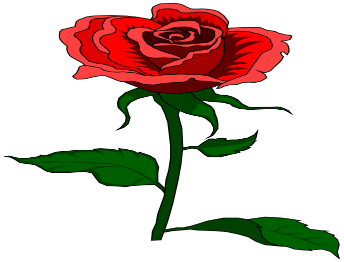
Over the past decades, there has been a revolution in the field of biology research and, more concretely, in biotechnology and genetic fields. This scientific development has led to a huge gap between what scientific comunity studies and what citizens know. In order to involve society in the decision-making process about scientific policies, we need well-informed citizens who are able to make thoughtful decisions based on scientific conclusions combined with ethical and moral considerations. The forefront to educate new generations is teaching. Teachers play a critical and central role in the education system and they are therefore an influential collective because they become teachers of the next generation.

The purpose of this thesis is to explore knowledge and attitudes towards biotechnology of pre-service teachers from a Northern (Sweden) and Southern (Spain) European countries. After that it is developed a new educational activity in order to make **future teachers literate of biotechnology**.

First, it was created a new questionnaire in order to analyse the knowledge, and attitudes of pre-service teachers. Data is analysed in a quantitative method. The results show that pre-service teachers from Spain and Sweden are interested in biotechnology topics and this research has also shown that their knowledge about basics genetics is lower than expected. Due to these first results, a new Problem-Based Learning (PBL) educational material has been developed. The aim of this educational material is to increase pre-service teacher's knowledge about genetics topics. A pre and post-test was created in order to validate the efficacy of this new educational tool, then data is analysed in a quantitative and qualitative approach. Finally, a significanlty increase of student's knowledge is proved with taking part of the learning activity. Moreover, most of the students involved in the activity expressed that they were feeling engaged to this educational dynamic.



THANK YOU



(Part.3)

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Cases Studies

(Egypt)

1. School Students

Abstract: The aim of this paper is to review and highlight some recent efforts to reform science education. The focus is to present science education in ways that are meaningful and reflective of the needs and interests of learners and their societies. Two main initiatives are presented that have picked up momentum and both emphasise interdisciplinary learning and a focus on developing 21st century skills as a global requirement. One of them is Education for Sustainable Development (ESD) while the other is Science, Technology, Engineering and Math (STEM) education.

initiatives with an aim to precisely review the board spectrum of how science education is interpreted within ESD and STEM practices. Moreover, the paper presents a more recent debate, which focuses on the deliberate shift from STEM to STEAM education. The focus of inquiry of this paper, therefore, is to research the possible models of introducing science education to the educational system in Egypt, within a framework that meets international calls for ESD and STEM/STEAM education. The paper contributes to the literature as it looks at a region at a transformational stage both politically and socially.

This calls for a need for education transformation with innovative ideas to meet the requirements of this stage. Infusing ESD/STEM/STEAM education through an innovative model of STE2AM education based on Freire's Liberatory Education in the educational system is a radical view but could be met with caution, preparation and readiness of all stakeholders in the system. With such view, this calls for political and practical changes in science teaching and learning in a country that is lagging behind in many developmental areas, where education is one of them.

education should provide and how to provide it. Freire actually provides a framework for how education helps societies learn and move forward with social change. It is therefore, the work of Freire which can provide this paper with a philosophical grounding to change to a sustainable future. The aim of Freire's Liberatory Education allows individuals to become informed citizens regardless of their socioeconomic status or social identity (Dale & Hyslop-Margison, 2010) that stresses on forming new relationships between students and teachers, students and learning, and students and society (McLaren, 1993).

both teacher and students. This forms a recipe essential for political and social change and above all a paradigm change that can lead to transformative actions. He also stresses the role of culture and context where learners work within various local contexts while acknowledging the larger whole of which they are part. According to Freire, his suggested Liberatory pedagogies dissocializes students against anti-intellectual and authority-dependence culture in an attempt to expose students to democratically engaging practices (Rodriguez, 2008).

to present a combination of four main disciplines of Science, Technology, Engineering and Mathematics. The integrated model of STEM education removes the traditional borders known between each discipline and provides opportunities to integrate disciplines in a cohesive meaningful experience where science and mathematics (main disciplines in the acronym) are learnt in a personalized context while developing various skills such as critical thinking, problem solving, communication skills, inductive and deductive reasoning and inquiry skills (Thompson, 2013).

According to Vasquez, Comer, and Sneider, (2013) STEM education is not a curriculum by itself, but it is an approach for teachers to organize and deliver instructions in a way that helps students apply their knowledge with their peers in meaningful situations. Especially as real life problems are not found in separate disciplines (Wang, 2012).

emergency'.

Total reform of the current educational curriculum with a marriage of the arts and sciences must happen. Tarnoff (2010) and Pomeroy (2012) echo this view and claim that STEM education is missing a set of creativity components and skills that are summarized under the letter "A" for Arts.

This set of skills comes particularly essential to jobs where the 'flattening or 'levelling effect' are taking place in the world's current workforce (Friedman, 2007).

teamwork.

Looking at the combination of 'A' STEAM education skills and links to brainbased-research shows an emphasis on both hemispheres of the brain (right brain hemisphere responsible for creativity and left brain hemisphere responsible for academia and logic) as a whole brain system. Unfortunately most science education teaching and learning practices in the States (White, 2010) and in the Arab countries focus on the left hemisphere and neglect the right side of the brain.

Science education within the STE^{2}AM education integrated model

This paper presents a model that presents science education in a model known by STE^{2}AM where STEAM education is integrated with ESD as a local need rather than a readymade imported education model. For Eijck and Roth, (2007) 'high-quality science education is required not only for sustaining a lively scientific community that is able to address global problems like global warming and pandemics, but also to bring about and maintain a high level of scientific literacy in the general population' (p. 2763). With concerns of disturbing

the educational ecological system with a foreign educational model, the 'E' in STE^{2}AM is represented by 'ESD' in addition to the original 'E' that represents 'engineering design'. Figure 2 shows the possible pedagogical approaches that could be implemented to present science education in the new STE^{2}AM model where interdisciplinary learning is at the core. The figure also illustrates two main pillars that the model is built upon. These are the 21st century skills that are essential for STE^{2}AM learning in addition to the concept of 'globalization', which helps learners and citizens think globally, yet act locally. STE^{2}AM education in its localized framework seems therefore an applicable model in the educational system in Egypt to facilitate linking education to the community and real-life situations through 'E' for engineering in addition to 'E' for ESD. In this way students will become accustomed to seeing sustainability and will carry those expectations with them to their future places of employment. Nevertheless, one of the major success factors is the readiness of the teachers, schools, curricula, assessment and moreover a policy maker to ensure that such transition is possible. The following recommendations are presented to develop a customized STE^{2}AM education model as follows:

1. Develop STE^{2}AM education standards and indicators according to research-based standards that align with both STEM/STEAM and ESD education.
2. Design professional preparation programmes in science teacher pre-service programs that present STE^{2}AM education integrated modules on pedagogical practices (i.e. place based learning and issue analysis) and integrated curricula design units using the backward design approach and project based learning, especially as this is not the customary means found in teacher education programs in Egypt (Biasutti & EL-Deghaidy, 2014).
3. Design professional development programs for in-service teachers to develop their capacity with the various pedagogies applicable to STE^{2}AM education which emphasises a student-centred approach and link to meaningful real life issues. There should be consideration to what teachers need in terms of their pedagogic content knowledge PCK, content knowledge CK and knowledge of context KC (Shulman, 1987).
4. Continuous professional development programmes (CPD) need to take into account teachers' needs rather than follow a top-down approach in the design process. Studies show those taking teachers' voices into account in the planning and design stages are fatal (Mansour et al., 2014).

5. Design curricula units based on the backward design that emphasizes on core problems of relevance to ESD issues and problems and are articulated as a sequence of topics and units. Table 1 illustrates examples of how to infuse STE^2AM education at the various stages including community and technical schools.
6. Ensure there is time allocated to the STE^2AM units to be presented to learners either as elective courses or extra-curricular activities.
7. Develop a STE^2AM school culture based on dialogue and mutual understanding between learners, teachers, administrators and parents.
8. Develop effective systems of assessment that shift from traditional pencil and paper tests to authentic-assessment based on performance and understanding and that align with the suggested STE^2AM model and standards.
9. STE^2AM community engagement and partnership based on university professional development programs as educators' partnership.
10. Bridge the gap between business and educational goals to create a more productive and sustainable global culture based on teamwork and workforce partners whether private or public.
11. Establish a network among higher education institutions that appreciates cross-institutional courses and teaching.

Interdisciplinary
Natural resource accounting
5Rs
Local-global links
Problem-based/ Project- based
ESD
STE²AM
=
STEM
+
Arts
+
ESD
STEM
Democracy
Basic- human needs
Gender equality
Inquiry-based/ Place-based
Social
Environmental
Economic
Science
Technology
Engineering
Mathematics
Issue analysis/ Multiple perspective based
Drama/ Brain-based learning
Bio-diversity
Human rights
Media-literacy
Carrying capacity
Ecological footprint
Eco-efficiency
Globalisation
21st century skills

Table 1. Examples of infusing STE^{2}AM education in the educational system in Egypt

Conceptualization	STE^{2}AM Education Framework			
Means of infusing STE^{2}AM education for each school stage/type	Elementary Stage	Middle & High school	Technical schools	Community Schools
	Block schedules & interdisciplinary activities	STE^{2}AM related subjects' lessons, interdisciplinary projects, and extra curricula activities	Partnership interdisciplinary projects with public and private industries and career guidance	Community based real life problems to be solved using interdisciplinary learning/ low technology

CONCLUSION

Education for Sustainable development is based on the idea that communities and educational systems within communities need to dovetail their sustainability efforts. Throughout the paper various examples of innovative science education approaches were illustrated. The paper ends with a model on STE^2AM education where there is integration between STEAM and ESD disciplines. The urgent need for Egypt to cater for ecological issues is the main reason for this shift of attention from STEAM where the 'E' represents engineering only to that which represents engineering in addition to ESD. Moreover, STE^2AM education has at its core integrated disciplines where learners are engaged in collaborative meaningful contexts that relate to everyday life issues in the local, regional or global community to address major ESD concepts. Yet, it has to be noted that the model could be applicable if teachers, students and administrators are aware of such shift and show empathy towards it.

USAID
FROM THE AMERICAN PEOPLE

BASIC EDUCATION

With more than 18 million students, Egypt is home to the largest school system in the Middle East. Students have near-universal access to primary education and boys and girls attend school at nearly equal rates. Due to rapid population growth, enrollment is rising steadily at both the intermediate and secondary levels, affecting the quality of the education system. With one-third of the population under the age of 15, the availability of schools and trained teachers cannot stay apace. Moreover, instruction has traditionally focused on exams rather than on developing critical thinking and practical skills.

In 2017, the Ministry of Education launched an education reform agenda to transition Egypt away from a system that emphasizes rote memorization toward a system that promotes skills and competencies through student-centered classrooms. USAID works closely with the Ministry as it implements these reforms and aligns the education system more closely with the needs of a modern economy, including the development of students' critical thinking and practical skills. These reforms focus on (1) expanding access to quality early childhood education; (2) improving student assessment systems; (3) increasing the quality of instruction through professional development activities for educators and administrators; and (4) incorporating technology in the classroom to include more digital resources and improved classroom data collection.

In partnership with the Ministry of Education, USAID helped establish Egypt's first two Science, Technology, Engineering, and Mathematics (STEM) high schools in Cairo in 2011 and 2012. The success of these schools has resulted in the Ministry expanding the model to twelve additional schools, while still maintaining the high quality, inquiry-based education of the original two STEM high schools. USAID is now supporting the development of teacher education programs at five Egyptian public universities to develop a cadre of highly capable STEM teachers for the STEM high schools.

USAID works with the Ministry to improve reading and mathematics in primary schools nationwide through providing early grade reading and math materials to improve learning outcomes and to strengthen teacher professional development. Additionally, USAID is working to eliminate illiteracy among Egypt's most vulnerable populations using an innovative, intergenerational literacy approach for mothers and their primary school-aged children in community schools in some of Egypt's most rural regions.

STUDENTS AT MAADI STEM SCHOOL FOR GIRLS PHOTO: USAID

ACTIVITIES

LITERATE VILLAGE: Literate Village is a four-year activity that focuses on 2,150 economically disadvantaged villages in the Sohag, Beheira, and Assiut governorates with high rates of illiteracy among mothers and low school attendance rates among children. Using an intergenerational approach to learning to eradicate illiteracy, this activity strengthens literacy among children in community schools and improves early grade reading instruction, particularly for remedial readers. The Literate Village activity works simultaneously with adult learners – namely mothers and women's groups – to provide literacy classes and teach women how to engage their children in learning in the home. The activity also works with community associations and leaders to garner support for literacy and encourage school attendance, creating an entire network that supports reading at every level. Implementing Partner: Save the Children Federation, Inc.; Life of Project: March 2017 – March 2021; Total Estimated Cost: $17 million; Governorates: Assiut, Beheira, Sohag

EARLY GRADE LEARNING: This government-to-government activity focuses on early grade learning in support of the Ministry of Education's reform agenda. It builds on previous USAID programming to ensure that Egyptian students are able to learn the fundamental core skills of reading, comprehension, writing, mathematics, and English language by the end of their early primary school experience (grade 3). This activity also provides remedial learning for students in grades 4-9 who have difficulties reading at their grade level. More than 300,000 teaching manuals are being distributed, including scripted lesson plans for teachers. The activity will reach over 150,000 teachers and 7.2 million children in grades 1-9 in 17,000 schools nationwide. This activity is strengthening the Ministry of Education's ability to provide demand-driven early grade teacher training and to implement decentralized planning and budgeting based on local needs and opportunities. Implementing Partner: Ministry of Education; Life of Project: September 2017 – September 2021; Total Estimated Cost: $15 million; Governorates: Nationwide

STEM TEACHER EDUCATION AND SCHOOL STRENGTHENING: This activity supports the introduction of pre-service teacher development programs in five selected faculties of education at Egyptian public universities. Future STEM teachers are receiving quality preparation for teaching in modern STEM classrooms, thereby providing a continuous supply of well-prepared teachers and raising the quality of teaching and learning at the secondary level STEM schools. USAID continues its support to the Ministry of Education to fully institutionalize the processes necessary to ensure the sustained quality of STEM schools, including supporting in-service training for teachers and administrators at the school, district, and governorate levels. Implementing Partner: 21PSTEM; Life of Project: April 2018 – April 2023; Total Estimated Cost: $24.27 million; Governorates: Nationwide

FABRICATION LABORATORIES FOR STEM SCHOOLS: This activity supports sustained quality STEM education by providing laboratory equipment to STEM schools and offering training in supply maintenance and equipment use. This includes science equipment for use in chemistry, physics, and biology laboratories as well as teacher training on equipment usage. Implementing Partner: Transcentury Services; Life of Project: December 2017 – June 2019; Total Estimated Cost: $4.47 million; Governorates: Beni Suef, Qena, Qaloubiya, Sharqia

REFUGEE EDUCATION: There are an estimated 200,000 refugees and asylum seekers in Egypt, more than half of whom are from Syria and 40 percent of whom are children. As part of the United Nations-led *Refugee Resilience Response Plan*, this activity works to ensure that vulnerable refugee children and youth, as well as their peers in the host community in Egypt, have access to quality formal and non-formal education services in safe learning environments. The activity strengthens community-based approaches to education to ensure greater enrollment of Syrian children. It improves quality of education through professional development opportunities for key education personnel from the target schools. It also works with Egypt's Ministry of Education to ensure barriers to education for refugee children are systematically addressed and minimized at the policy level. Implementing Partner: UNICEF; Life of Project: 2017 – 2019 (managed by USAID/Washington); Total Estimated Cost: $5 million; Governorates: Alexandria, Cairo, Damietta

Cases Studies

(Egypt)

2. University Students

CAIRO AMERICAN COLLEGE

CAC CURRICULUM

Print , Email

At CAC, students are involved in traditional subject areas: Reading and Writing, Mathematics, Science, Social Studies, World Languages, Arts, and Physical Education. The curriculum for PreK-12 emphasises inquiry-based learning and the Elementary and Middle Schools use standards-based grading and reporting. Students demonstrate their learning through tests, written assignments, oral presentations, projects, demonstrations, and discussions.

Students in grades 3-9 participate in MAP (Measures of Academic Progress) testing. The High School offers the International Baccalaureate Diploma Program in grades 11 and 12. High school students participate in the SAT and ACT assessments as part of their college application process.

CAIRO AMERICAN COLLEGE

LEARNING AND TEACHING PRINCIPLES

Learning Principles

Rigor

Substantive learning involves breadth, depth, challenges and connections, where content is linked to transferable core concepts, high expectations are communicated and higher order thinking skills are elicited.

Social

Learning is social and is strengthened by thoughtful discussions, interactions, and collaboration with others.

Constructed

Learning is constructed through the interaction of prior knowledge and established patterns with new content, skills and frameworks; it is strengthened when new knowledge is meaningful and has a purpose

Environment

Learning occurs best among supportive, caring and respectful relationships where the physical environment and classroom climate are positive.

Feedback

Learning involves practice, mistakes and feedback. Immediate and specific feedback, as well as self-reflection and peer reviews, strengthen learning.

Teaching Principles

Growth Oriented

Learning is strengthened when there are coherent goals aimed at the academic and social growth of students. Growth oriented teachers are expert in their field. They are passionate about teaching and learning, partake enthusiastically in meaningful professional development and share their learning with their colleagues.

Engagement

Learning is strengthened through the skillful use of engaging instruction, questioning, and inquiry practices which address a broad array of learning styles. Engagement is strengthened by highly positive relationships with students.

Developmental

Learning can occur in both a linear and nonlinear, developmental fashion. It is strengthened when teachers accept mastery, as appropriate, when demonstrated by a student in any form, via traditional or nontraditional assessment, and when students pursue self- efficacy.

Intentional

Learning is strengthened when instructional time is highly valued and used with purpose. Teachers consistently and seamlessly use classroom procedures to support learning and the CAC Core values. Teachers have, can share, and reflect upon the progress and success of a yearly (or semesteral) game plan for their course.

Reflective

Learning is deepened through thoughtful student and teacher reflections and analysis of student assessments in relation to overall patterns in the class, grade, school and international data.

CAIRO AMERICAN COLLEGE

Our model and our practice centers around student learning. Five research-based learning principles encompass our understanding of powerful student learning and inform our teaching principles. These principles enhance learning and lead to a series of teaching protocols embraced by educators at CAC.

Home
Curriculum Night
MAP Assessment
6D Schedule
About Ms. Dircks
Absence
Academics
Homework
Math
Reading
Research Tools
Social Studies
Spelling
Vocabulary
Writing
Battle of the Books
Extra Credit
Photo Album
Projects
Ancient Egypt Inquiry
Holidays Around the World
Resident Expert Project
Scholastic Book Orders
Student Picks
Sitemap

Projects >

Ancient Egypt Inquiry

Click on the link below for information about the Ancient Egypt Inquiry project.

https://sites.google.com/a/student.pleasval.k12.ia
inquiry/

Strong learners are able to ASK deep questions, RESEARCH to gather information from multiple sources, and then DRAW A CONCLUSION. That's what the INQUIRY process is all about!

Here are the steps you'll follow:

1. Immerse yourself in a study of Ancient Egypt (guided reading nonfiction stories about Egypt, nonfiction library books, fiction novels, videos, Putnam field trip, and our S.S. textbook) each day at school.
2. Determine an area of Ancient Egypt that YOU are interested in. Don't worry about what others are choosing, find something that excites YOU.
3. Come up with an INQUIRY QUESTION. Not a research question (we'll discuss the difference...and you'll find a menu of INQUIRY QUESTIONS you can choose from on the link at the top of this page).

4. Complete additional research that is more specific to your INQUIRY QUESTION.
5. Look over your research and draw some conclusions.
6. Present your research findings and conclusions in a meaningful way, ie: research paper, Prezi, Power Point, brochure, poster, etc. *Sample projects are located in the link at the top of this page.
7. **Always, always, always remember that the IMPORTANT PART of an INQUIRY RESEARCH PROJECT is the research you complete, the conclusions you draw, and the process of investigating...the focus is NOT on having a fancy-schmancy final projects with lots of bells and whistles.

RESOURCE SHOP

- HTAV Senior History Series
- New
- Forthcoming
- Primary
- Middle Years
- Senior
- eBooks
- Sample Exams (current study design)
- Teacher Resources & BLMs
- Merchandise & Posters
- Agora & Professional Reading
- Clearance
- 2020 Booklists
- Catalogue
- Terms & Conditions
- Order Form
- Current postage charges

NOTE: Whilst every effort is made to process orders promptly, allow 7 working days for goods to be dispatched.

Ancient Egypt (Inquiry-Based Learning Series)

Author: Adrian Puckering

Publisher: HTAV

Length: 42pp plus CD

Item number: 1043

ISBN: 978 1 875585 92 2

AU $55.00 (incl GST)

BUY

VIEW SAMPLE PAGES

- includes CD
- blackline master (licence to copy)

What did Ancient Egyptians believe about life and death?

A complete blackline master unit of work for teachers.

This unit examines life and death in Ancient Egypt. It uses a range of primary and secondary sources to address the following inquiry questions:

- *What was the meaning of life and death in Ancient Egypt?*
- *How were dead bodies treated?*
- *What have uncovered tombs revealed?*
- *Who ran ancient Egypt?*
- *Were ancient Egyptians treated better in death than in life?*

FEATURES

- Primary source documents and images
- Historical context
- Learning objectives and outcomes
- Stimulating inquiry questions
- Step-by-step lessons that can be followed or adapted
- Activities for a range of learning styles
- Assessment tasks

Cases Studies

(Egypt)

3. Child University

children's
UNIVERSITY
جامعة الطفل

Children's University mission is to prepare **Egyptian children** for the future as change agents capable of facing different challenges and shaping the world through their developed creativity and innovative ability. Today's **children** are tomorrow's tools for building modern **Egypt** and boosting the **Egyptian** community.

The Child's University Program - File photo

A Child’s University: Allowing children insights into their futures

By: Malak Asaad   Mon, Oct. 30, 2017

CAIRO – 30 October 2017: The criticism and complaints about the deterioration of the Egyptian educational system gave rise to initiatives aiming to develop the methods of education and enhance children's abilities, encouraging their innovation; these initiatives have ranged from Japanese schools to A Child’s University.

The project's manager, Gena el-Feky, said that 27 Egyptian universities participated in the program, aiming to develop what children have already studied in schools, stressing on providing the experimental opportunities in the laboratories as schools' education lacks practicalities.

Feky added that the Academy of Scientific Research and Technology has designed simplified courses for kids, in addition to training university professors on how to deal with children.


Children's University
جامعة الطفل
أكاديمية البحث العلمي والتكنولوجيا
Academy of Scientific Research & Technology
Children's University
جامعة الطفل


Children's University
جـــامعـــة الـطفـــل
أكاديمية البحث العلمي والتكنولوجيا
Academy of Scientific Research & Technology


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Academy of Scientific Research & Technology

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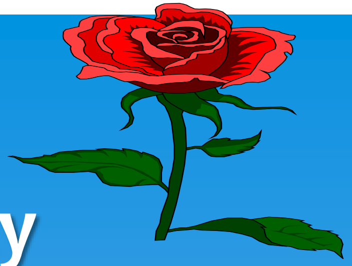
جامعة الطفل
Children's University
جامعة الطفل

Cases Studies

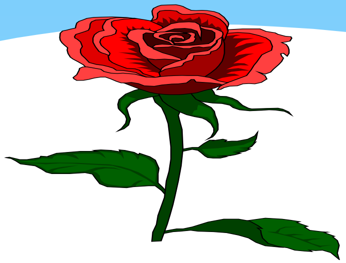
(Egypt)

4. Museums as a way of inquiry-based education

The Grand Museum of Egypt
&
The Challenge of Sustainability



Dr. Walid A. Moneim
Dr. Zeinab Shafik
Dr. Yasser Mansour



basic objective was preservation and safe keeping of irreplaceable items. The idea that the artifacts displayed represent a country's heritage or a nation's pride justified even more this philanthropist approach. With the increase in the extensive variations in the typology of museums based on the artifacts displayed and with the variations in the size of museums, the goal of building a museum faced a substantial change. Museums are now established to serve different groups of visitors with variations in the level of their sophistication and intellectual background.

exhibits displayed control and direct its design and provide guidelines for its operation after construction. Thus, museums developed like any other building type directed to serve members of the community. With this orientation the concept of the museum as a philanthropist act has also developed. With the advancement in economic sciences, marketing strategies and business oriented feasibility studies, museums are thought of as institutions which can be revenue generating, self sustainable and even profit making structures. Accordingly the initial program of the museum building is based on activities and spaces which can bring in an income to that institution.

represents a gateway leading to an experience of understanding the form of life that existed in Egypt thousands of years ago and a window open to everyday life sustained in Egypt today. It is a two fold objective that pulls the ancient legends to the essence of "Egyptianess" as it is lived in contemporary Egypt. In its own philosophical approach the GME sustains the culture that exists in the Egyptian context by linking it to its historical roots and perpetuating its greatness via different activities and facilities that are offered in a building of a world class standard.

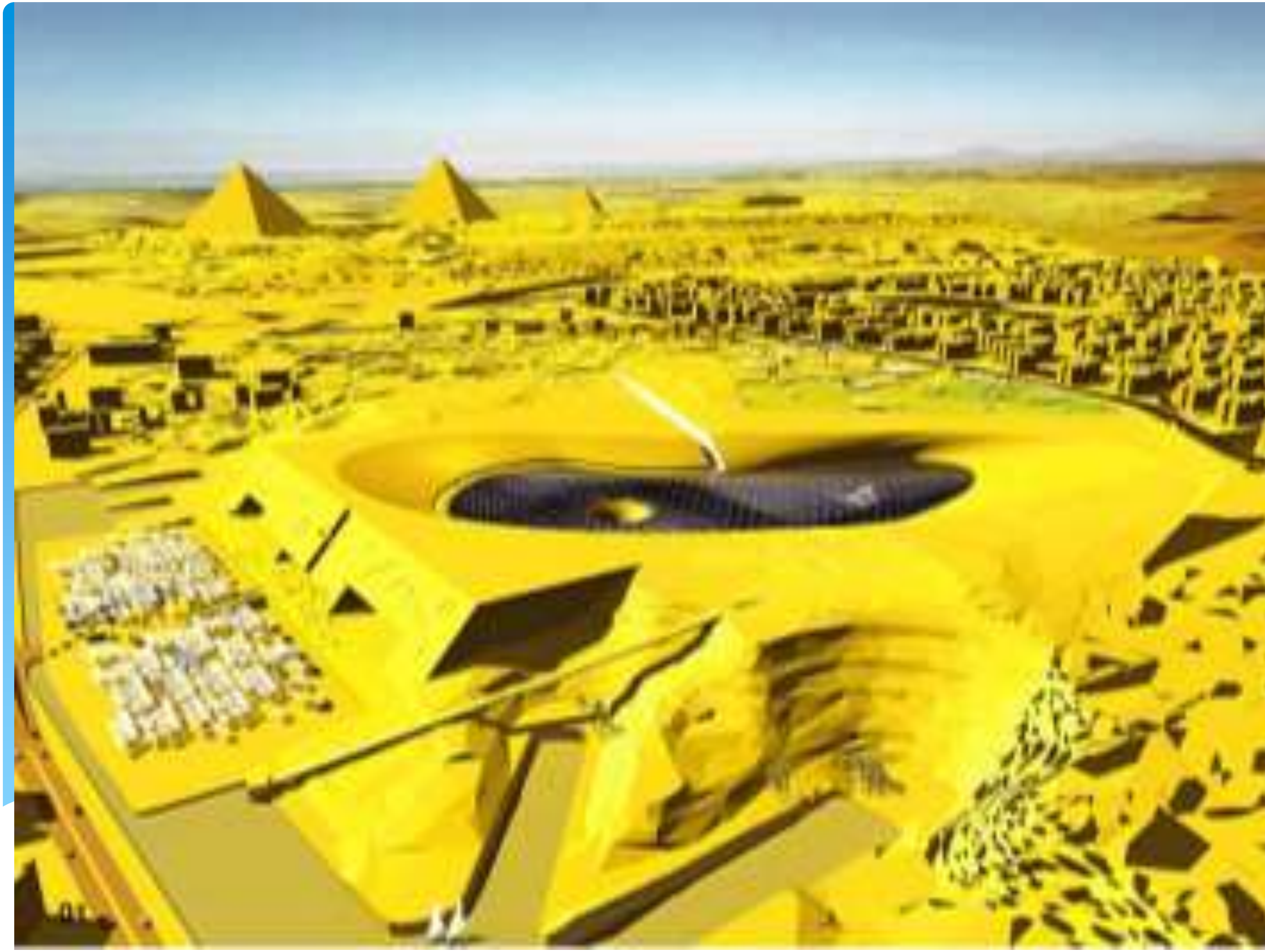
The Grand Museum of Egypt
&
Educational Facilities

world will find common grounds in the information offered to them via the channels of the GME, this provides an opportunity to excel and further navigate into the meanings withheld in the ancient Egyptian culture .

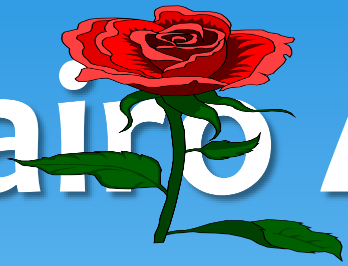
More importantly, the educational programs target the general public by raising the awareness of the layperson to the greatness of the heritage they withhold. The younger generation represents the target customer for the different educational programs, which is based on providing a hands-on experience in the children's museum, which is endorsed by the excitement delivered in the virtual galleries and the IT links, this allows the eager younger client to mix the pleasures of the scientific imaginary world of the virtual reality with the facts of history that anchor the Egyptians' roots to the land of the Nile.

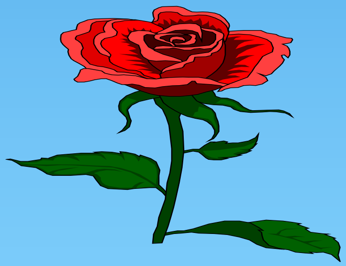
The Grand Museum of Egypt
&
Leisure and Pleasure

climatic conditions, the presence of the desert sand, and the reconstruction of the ancient pattern of agricultural land that sustained thousands of years of change. Life developed along the banks of the Nile and moved from one level of intricacy and complexity to the other, the Egyptians' experience, added knowledge and developed traditions produced layers of wisdom that created the most sophisticated civilization ever known. The life springing out along the valley survived gracefully through political changes, climatic disasters, administrative and oppressive rulers; it sustained itself miraculously under adverse circumstances. This story of a life experience of a culture is told in the gardens of the museum and its everydayness is reincarnated in its landscape design. The leisure parks revive the old wisdom but do not deny the lived reality by offering theme parks and equipped parks accommodating the most innovative facilities and equipment used in contemporary landscape.



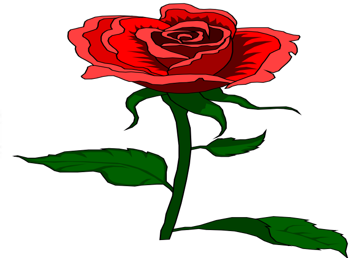
Cairo Agricultural museum





NOVEMBER 29, 2018 BY HAZINEEDITOR

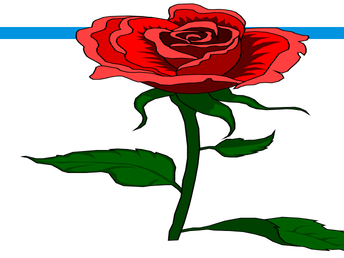
The Cairo Agricultural Museum and Library



Statue of a Peasant Woman in the Museum Gardens (photo credit: Taylor Moore)

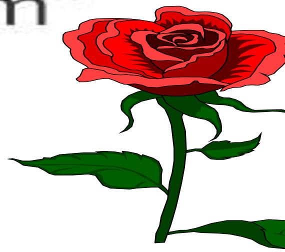
The Cairo Agricultural Museum complex, located right off of Salah Salem street in the neighborhood of Dokki, is a gem of object collections

History

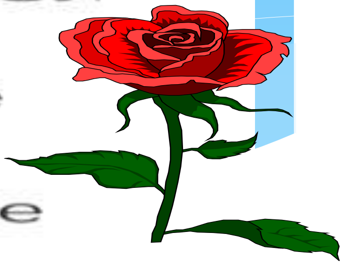


In 1930, King Fouad of Egypt established the Agricultural Museum in the Cairo suburb of Dokki in the palace of Princess Fatima, the daughter of the great Khedive Ismail. It is one of the first agricultural museums in the world—second only to the Royal Agricultural Museum in Budapest. The museum was officially inaugurated by King Farouk in 1938 when he selected the venue to host 18th International Cotton Congress.

18th International Cotton Congress. The Agriculture Museum was preceded by an array of agricultural expositions organized by the Khedival Agricultural Society (later Royal Agricultural Society), an organization determined to improve agricultural methods in Egypt, and "the lot of the fellah." The society created a small agricultural museum in 1920. This initial collection was ultimately modified into a cotton museum, which later became a part of the "Fouad I Agricultural Museum" when it opened to the public (el Shakry, 2007).

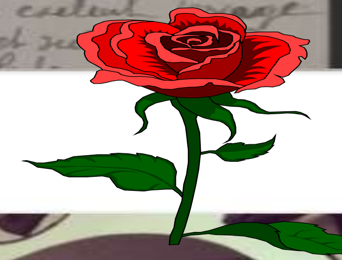


The Cairo Agricultural Museum complex, located right off of Salah Salem street in the neighborhood of Dokki, is a gem of object collections and archival holdings hidden in plain sight. Its under-utilized collections will be of interest to historians and social scientists working on agriculture, food, natural history, political economy, rural Egyptian history, and public works from the Pharaonic period until present day. The museum is also a rare find for scholars interested in material culture and museum studies in modern Egypt. Its exhibits stand as an archive in and of themselves. They provide material testament to developments in the natural sciences, anthropology, food science, visual culture, and curatorial practices as many of the collections and dioramas remain untouched since the first half of the twentieth century.



HAZINE

a guide to researching the middle east and beyond



≡ Menu

Wax museum

Dear Parents,

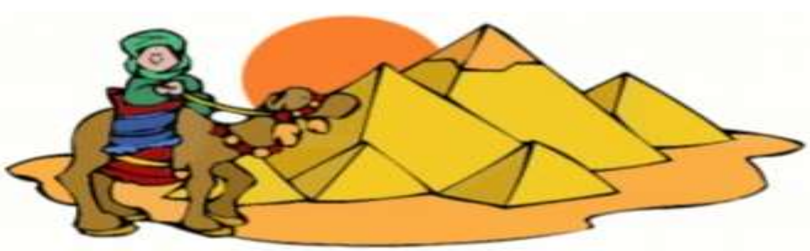
As part of our study of Ancient Egypt, the students will be presenting the first annual Torrey Hills Ancient Egyptian Wax Museum in the MUR. Please be sure to mark your calendar for February 12, 8:15 – 9:15 so you won't miss this exciting event. On this day, the sixth grade students will bring ancient Egypt to life for your viewing!

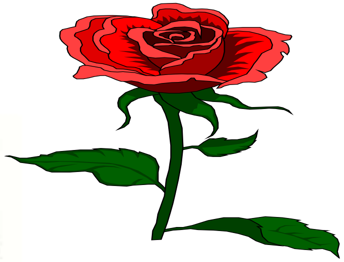
Each student has chosen an ancient Egyptian person/god/goddess to represent. As part of their presentation, your child needs to design a costume for the character they've chosen....think white skirts, gold belts and jewelry, sandals, black eyeliner, black hair, masks, etc. Finally they need to make a "Button Box" for visitors to press as a cue to begin their speech.

Students need to come to school dressed in costume on the morning of February 12th. Parents are invited to enter the Wax Museum in the MUR anytime between 8:15 – 9:15.

Have fun planning and preparing your costume and Button Box!

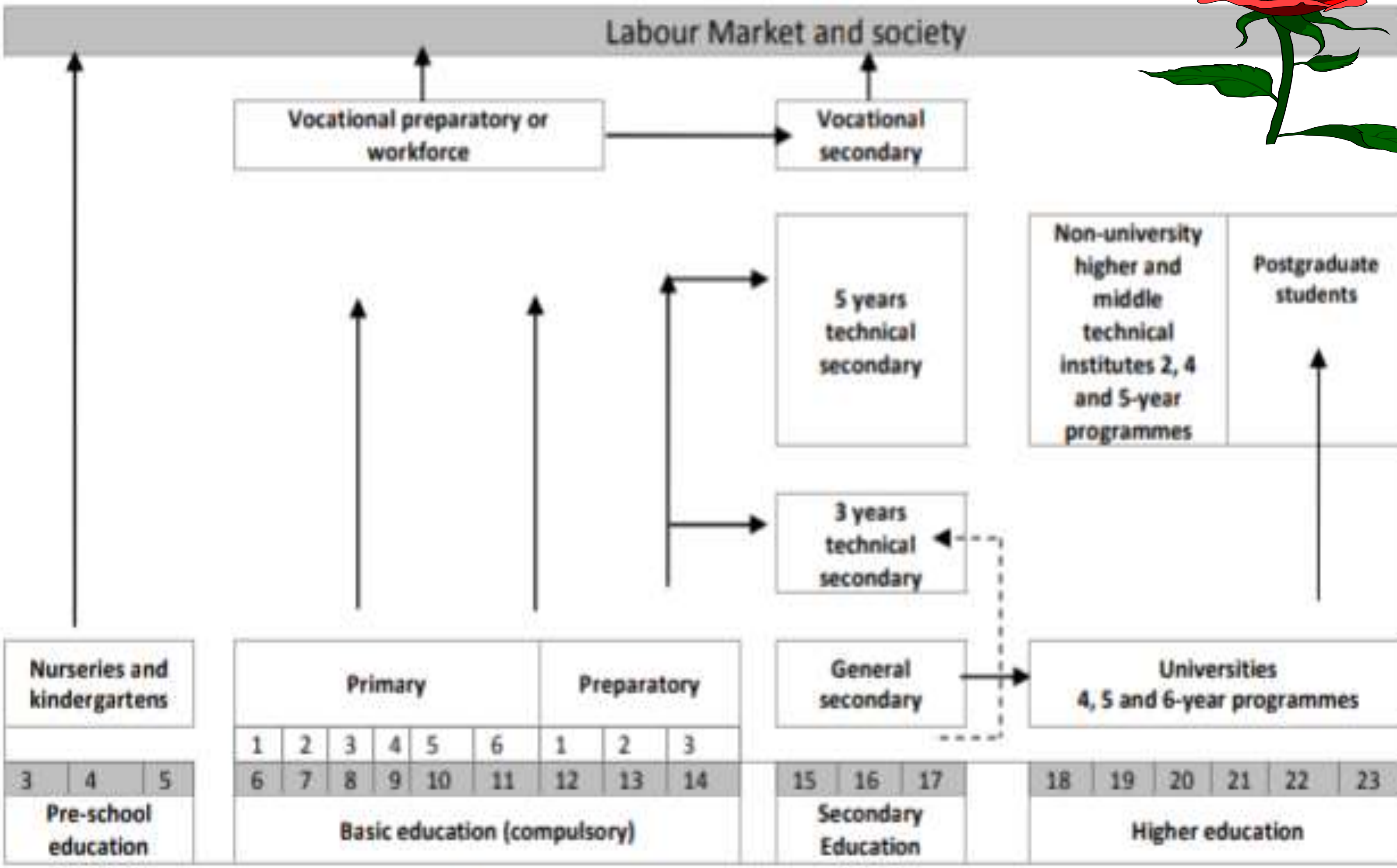
Thanks,
The Sixth Grade Team





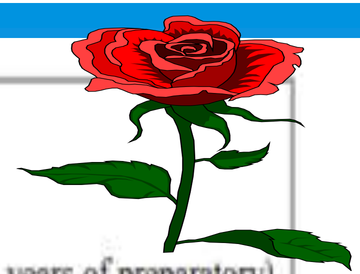
SCHOOLS FOR SKILLS: A NEW LEARNING AGENDA FOR EGYPT

OECD
BETTER POLICIES FOR BETTER LIVES



Source: Ministry of Education (2011), Pre-University Education System in Egypt: Background Report, Ministry of Education, Cairo.

The Egyptian Education System



Box 2.2 Stages and types of pre-university education in Egypt

Basic education (primary and preparatory): basic education (six years of primary and three years of preparatory) is a right for Egyptian children from the age of six. After Grade 9, students are tracked into one of two strands: general secondary schools or technical secondary schools.

General secondary education: this 3-year stage starts from Grade 10 and aims at preparing students for work and further education. Graduates of this track normally join higher education institutes in a highly competitive process based mainly on their results of the secondary school leaving exam (*thanawiya amma*).

Technical secondary education (industrial, agricultural and commercial): technical secondary education has two strands. The first provides technical education in 3-year technical secondary schools. The second provides more advanced technical education in an integrated 5-year model; the first three years are similar to those of the former type and the upper two years prepare graduates for work as senior technicians. Graduates of both tracks may access higher education depending on their results in the final exam. However, their transition rates are low in comparison to graduates of general secondary education.

Al-Azharite education: al-Azharite education follows the same direction as general education with regard to hours of study for each school subject. However, al-Azhar providers offer religious instruction as part of the curriculum.

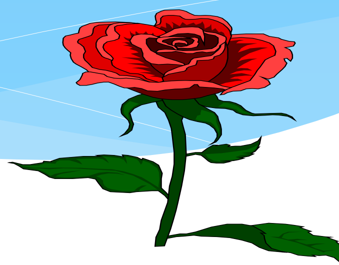
Stages and types of pre-University education in Egypt

modern economy. Traditional sources of employment are not growing at anywhere near the rate required to absorb new entrants to the labour market – whether school leavers or tertiary education graduates.

The urgent priority for Egypt is to make education and training relevant to its economic prospects. It will need to do so in ways that develop rounded citizens who can work together to build a cohesive society. The transformation that is required in Egyptian education involves improving the learning experiences and outcomes of schooling so that educated youth can be productive citizens. That involves shifting the orientation of Egyptian schooling from the acquisition and repetition of knowledge to the development and demonstration of skills.

means using assessment to monitor student progress and inform educational interventions, rather than as a crude and unfair tool for social sorting.

It means overhauling the underperforming, under-resourced and undervalued provision of technical and vocational education and training (TVET), by upgrading its capacity and status, reorienting its offerings to current and emerging labour market requirements, and integrating it as a system at the centre of Egypt's economic transformation agenda.



and reporting of progress against targets.

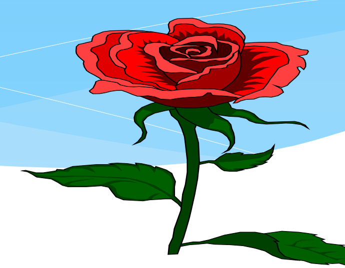
Less progress has been made, however, on the difficult challenge of improving educational quality. The common factor undermining efforts to improve student learning at all levels is the invalid system of student assessment and its improper use. It is invalid because of deficiencies in its design, and its use is improper because scores derived from its application unjustifiably determine the life chances of students. The most pervasive influence in Egyptian education is the secondary school leaving exam (thanwiya amma). It needs to be reconstructed, alongside the development of more valid and reliable assessment methods and a more flexible approach to university admissions.

their role as managing for results rather than just inspecting to ensure that particular matters are covered. They need to focus on what students are learning, and provide the support that principals and teachers need, including by diffusing good innovations in teaching practice. Teachers generally will need more focused support so that they can continue to improve their teaching, and the opportunity to share and learn with their professional colleagues. The formation of the Professional Academy for Teachers represents a major, long-term structural advance. Teacher education generally, especially pre-service teacher education, will need to be sharpened up and, in some areas, especially in technical and vocational education, reshaped.

to reshape secondary education, as well as TVET more broadly, and thereby helping to shape Egypt’s future labour supply. Serious attention needs to be paid not only to what change is required but also to how that change can be implemented, followed through and embedded in culture and practice in all classrooms, and in the steering and supporting arms of government administration at all levels. Considerable effort will need to be applied to making the necessary shift from an authoritarian and unaccountable management model to one based on transparent information that underpins accountability for performance at every level. Broad publicsector reforms will be necessary complements to the education-specific and labour market reforms identified in this report.

The economic base is in a dire condition, and several established industries are losing ground to global competition. Most of the working-age population do not have adequate skills for employment in a modern economy. Traditional sources of employment are not growing at anywhere near the rate required to absorb new entrants to the labour market. There is a severe scarcity of finance capital for investment in new enterprises and retooling of existing industries. Government spending will be severely constrained over the next decade.

The urgent priority for Egypt is to make education and training relevant to its economic prospects. It will need to do so in ways that develop rounded citizens who can work together to build a cohesive society. Effective investment in human capital formation is, therefore, critical. Effective investment means raising the productive capacity of the workforce. It also means producing an open and enlightened citizenry. And it means enabling all individuals – regardless of their personal characteristics and social backgrounds – to achieve to the full potential of their talents. Effective education means that students learn what they need to know, understand and be able to do for work, life and further learning.



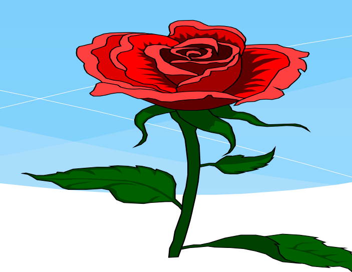
spending for education. In this environment, it will be important to harness the support of donors and co-ordinate their efforts with those of the government. Additionally, it will be necessary to increase private investment in the provision of schooling, within a policy and regulatory framework that safeguards quality and equity. Effective investment in human capital, however, does not mean merely spending more money on education, or merely producing more graduates with higher qualifications. Egypt has too little of the former and too many of the latter. Clear priorities need to be set and followed. That means deliberately deciding not to do some things at all, and to do some other things more slowly, in order that the most important things get done well as soon as possible.

Egyptian schooling from the acquisition and repetition of knowledge to the development and demonstration of skills.
That means reforming schooling fundamentally. It means not only giving a high priority to increasing equity of access to schooling but also giving much greater priority to improving educational effectiveness. It means focusing on how, and how well, students learn core cognitive skills. It means, therefore, reducing the current emphasis on curriculum content coverage, changing classrooms from passive to interactive places of learning, and using assessment professionally to monitor student progress and inform educational interventions, rather than as a crude and unfair tool for social sorting – ruling out for some, and limiting for others, their lifetime opportunities.

requirement is to improve the way young people develop the skills they need to participate in the labour market. That means re-committing to the 2007-2012 plans for secondary modernisation, including both general and vocational education. Continuing attention will also need to be paid to improving students' development of core cognitive skills in their early years of schooling.

The common factor undermining efforts to improve student learning at all levels is the invalid structure of assessment and its improper use. The most insidious and pervasive influence in Egyptian education is the thanwiya amma exam. Without its reconstruction, alongside the development of more valid and reliable assessment methods and a more flexible approach to university admissions, it is difficult to see real progress being made in educational practice and culture.

reform, and the directions that need to be pursued to make schooling more effective, and by their professional commitment, patience and persistence. In the view of the team, the major obstacles to substantive educational reform are embedded in aspects of Egyptian cultural norms that officials, notwithstanding their competence and commitment, cannot shift alone. Fundamental educational reform will involve largely counter-balancing, if not overturning, long-held and culturally embedded beliefs about what is worthwhile in educational purposes and processes in Egypt. Achieving success in this endeavour will require a genuine and open discussion about values. Among other things, this will mean taking the education debate to the core of Egypt's economic development dialogue.



young people they serve. They deserve clarity about key educational goals and specific objectives for improving student learning. They deserve respect for their professional ability to design learning experiences that enable students to achieve those objectives. The Ministry of Education has the responsibility to set the educational goals for Egypt's schooling system. The ministry needs to move away from input targets and to articulate goals for student learning outcomes. It has already embarked in this direction by articulating educational outcomes in terms of cognitive, personal and interpersonal skills, but these efforts are countered by a cluttered curriculum, teachers' preferences for teaching through recitation, and parental pressure for students to get high marks in the content-based exams.

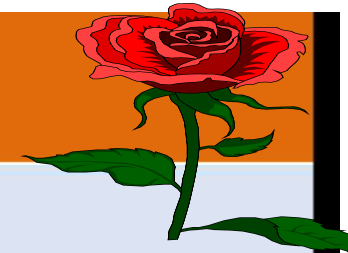
achieve. Teachers should have flexibility of ways and means to achieve improvements in student learning outcomes. The educational leadership at the muddiriyas and idaras need to see their role as managing for results, rather than just inspecting to ensure that particular matters are covered or to constrain what principals and teachers can do. They need to focus on what students are learning to do, and provide the support that principals and teachers need, including by diffusing good innovations in teaching practice. Teachers generally will need more focused support so that they can continue to improve their teaching, and the opportunity to share and learn with their professional colleagues. The formation of the Professional Academy for Teachers represents a major, long-term structural advance. Teacher education generally, especially pre-service teacher education, will need to be sharpened up and, in some areas, especially in TVET, reshaped.

should harness considerable educator support. Nevertheless, resistance to change is to be expected, including from both powerful and powerless quarters. It will be necessary, therefore, to call on the wider community of individuals, families and employers to champion the necessary changes and help make them possible. Employers, especially in private-sector enterprises, which will be the main source of Egypt's future economic base, should have a strong say in helping to reshape secondary education, as well as TVET more broadly, and thereby helping to shape Egypt's future labour supply. Serious attention needs to be paid not only to what change is required but also to how that change can be implemented, followed through and embedded in culture and practice in all classrooms, and in the steering and supporting arms of government administration at all levels.

information that underpins accountability for performance at every level. As noted in preceding chapters, there are underlying issues of governance beyond the education sector that will need to be addressed for educational reforms to be effective. Broad public-sector reforms will be necessary complements to the education-specific and labour-market reforms identified in this review.

There is much in the contemporary Egyptian condition to give cause for despondency but much more to give hope in the potential of Egyptian youth to forge a new future. Egypt's basic challenge, its basis for recovery and its source of future strength, is to let its people learn to learn.

THE AMERICAN UNIVERSITY IN CAIRO
GRADUATE SCHOOL OF EDUCATION



Quality Education for All in Egypt: "Post 2015 Education Development Goal"

Case Studies

Nagwa Megahed (Ed.)

2016

Foreword by
NDri Assie-Lumumba

COMPARATIVE EDUCATION RESEARCH SERIES

Figure 1. Education Reform Program in Egypt (2004 - 2009)

Education reform Program in Egypt (2004-2009).

Department gave me greater insight into the issue at hand. The problem faced now is that students are expected to achieve a high grade point average in the subjects that will enable them to enter university.

These subjects are the ones that are taught in English, and consequently they are seen as core subjects. Therefore, the students put all their efforts in trying to achieve high academic ranking to be able to pass the core subjects. However, according to the Arabic HOD, since the subjects taught in Arabic are not a part of the student's grade point average, therefore, less efforts is put on achieving grades on these subjects. He explained that this leads the teacher to feel discouraged and consequently marginalized. Which connects very well with what the HR manager said earlier.

choose to manage the curriculum. Subsequently, when it comes to classroom management, the marginalized teachers find it exceedingly hard to control their students and have a well-established learning environment. The core teachers were able to provide their students with an effective learning environment by being able to manage their classes. The core teachers were able to set classroom procedures that were effective and they used strategies that would make them able to handle a classroom and productively use class time. That is because classroom management also entails teacher‘s ability to be able to manage time and provide students with tasks that would allow them to effectively use class time and not waste the lesson (Compilation of professional development core content to support the new teacher induction program: A resource for broad NTIP teams, 2010).

of their students they are able to formulate a relationship in the classroom that is based on mutual respect and understanding.

This relationship helps educators provide their students with a beneficial learning environment. If there is no respect between the two parties, then the learning experience is jeopardized. Broad and Evans (2006) explain that it is very important for teachers and students to respect each other because this links both the student and the teacher and helps them both to achieve the task they are working towards, which is quality education.

Cox, 2011). The marginalized teachers are not very keen on using technology in the classroom because they do not view it as an important aspect. In comparison with the core teachers, they make it a point to use videos and PowerPoint in order to make their classes more interesting and to engage their students more. All the above-mentioned issues and problems explain why the researcher concluded that Mr. C and Ms. R are marginalized in their own working environment. Whether the school does that on purpose or not is beside the point. The important thing to notice here is that the power struggles demonstrated in how the core teachers are treated in comparison to the marginalized teachers, and how the school administration gives prestige to some teachers over others affect how teachers do their job, which leads me to this paper‘s conclusion.

subject they teach are directly related to the level of respect they receive from students and colleges. When students know that specific teachers and their subjects are not regarded as important in the school, they start acting accordingly. Their actions may be in the form of constant misbehavior, displaying disinterest in the subject and teacher, and a constant urge to break the class rules. All these factors start to build up inside the teacher causing them to lose interest in effectively managing the classroom and negatively affect their teaching techniques.

very discouraging. Issues such as the salaries they receive and their position in the school are enough to discourage teachers and hold back their performance.

This research could be taken further by looking deeper into power struggles in schools. More observations need to take place with a wider sample covering more schools. Arabic classes could also be observed to see if the predictions made in this paper involve the subject that teaches student how to think, read and write in their mother tongue.

Thank You Very Much

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Personal Experience

My Books
in the Area of
Simplification of Sciences
and
Education of Students

Azhar University

Dr Eman A. Alam

(2017-2019)

ACTIVE LEARNING AND EDUCATION OF SCIENCES THROUGH INQUIRY BASED LEARNING AND EDUCATION OF SCIENCES

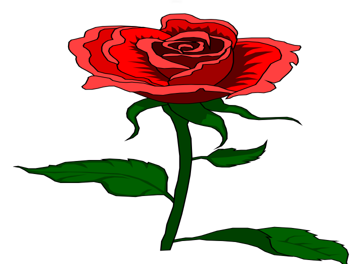
(1-BIOTECHNOLOGICAL SCIENCES)

By

Eman A. Alam

Lecturer at the Botany Department, Faculty of Science,
Girls Branch, Al-Azhar University,

Nasr City, Cairo, Egypt



Plant Biotechnologies
And
Pharmaceutical Products

By

Dr. Eman Abdel – Samiaa Ali Hussein Alam
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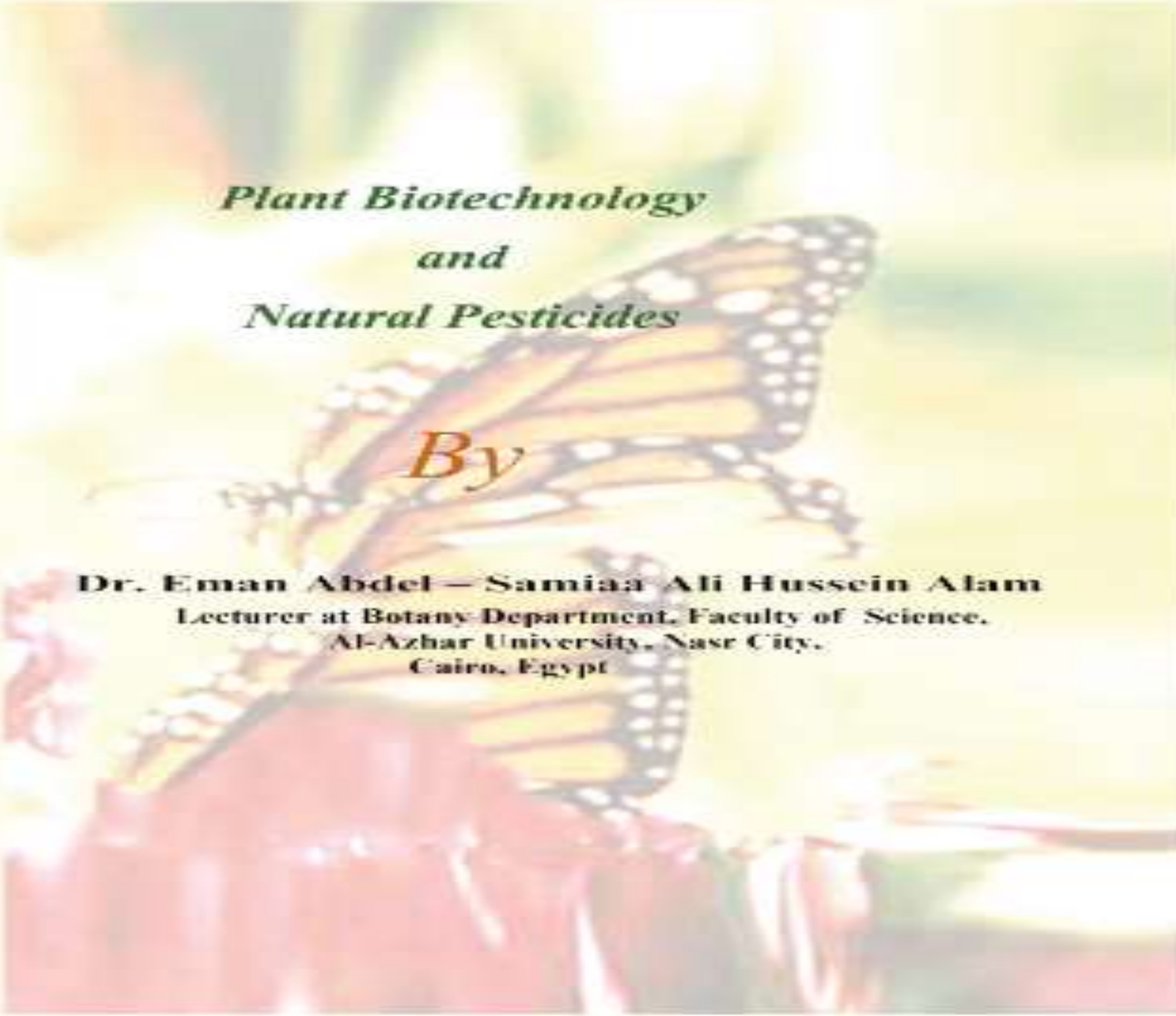
Al-Azhar University, Nasr City,
Cairo, Egypt


Plant Biotechnology
and
Natural Pesticides
By
Dr. Eman Abdel – Samiaa Ali Hussein Alam
Lecturer at Botany Department, Faculty of Science,
Al-Azhar University, Nasr City,
Cairo, Egypt


سلسلة تبسيط العلوم لمبادرة
بالعلم هتبقى جنة
الكتاب الثانى
مقدمة فى المعلوماتية الحيوية
تأليف
م . عمرعبدالسلام المحمدى
الفرقة الرابعة قسم البيوتكنولوجي - كلية الزراعة - جامعة الأزهر الشريف
مراجعة
د . إيمان عبد السميع على حسين علام
مدرس بقسم النبات والميكروبيولوجي - كلية العلوم - جامعة الأزهر الشريف
رئيس ومؤسس مبادرة بالعلم هتبقى جنة

Bioinformatics

POPULARIZATION OF SCIENCE

(A CASE STUDY: PLANTS MENTIONED IN THE HOLY QURAN)

By

Eman A. Alam

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Girls Branch, Al-Azhar University,

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التغذية والإبداع العلمي

(أكثر من خمسين صنف غذائي هام للمبدعين)

تأليف

د .إيمان عبد السميع علام

مدرس بقسم النبات بكلية العلوم

جامعة الأزهر فرع البنا ت

Diet and Innovation

Alphabets of a scientific paper

(How to write a scientific paper using some simplified roles derived from letters included in the name of each part of the paper)

By

Dr. Eman Abdel-Samiaa Ali Hussein Alam
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Al-Azhar University, Nasr City,
Cairo, Egypt

Alphabets of a scientific paper

Exercise Book

(How to write a scientific paper using some simplified roles derived from letters included in the name of each part of the paper)

By

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How to simplify the scientific writing

By

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Cairo, Egypt

بالعلم هتبقي جنه

(العدد الأول)

المشاركه في الملتقيات العلميه
وكيفية إعداد بحث علمي أجنبي

تأليف
د .إيمان عبد السميع علام
مدرس بقسم النبات بكلية العلوم جامعة
الأزهر فرع البنا ت

Participation of Students in Scientific Meetings and Preparation of a Scientific Paper

THE WAY TO THE FUTURE

(FUTURE STARTS FROM NOW, SO I AM PLANNING FOR IT FROM THIS MOMENT)

BY

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القرآن الكريم وتبسيط العلوم

(١- عالم النبات في القرآن الكريم)

By

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Simplification of Science

التكاثر الجنسي في النباتات

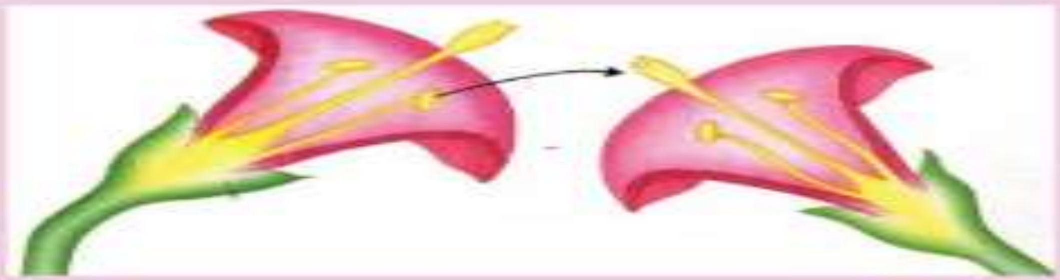
(الجزء الأول : الأزهار)

تأليف

د .إيمان عبد السميع علام
مدرس بقسم النبات بكلية العلوم
جامعة الأزهر فرع البنات

Sexual Reproduction in Plants (Part.1)

التكاثر الجنسي في النباتات



تأليف
د .إيمان عبد السميع علام
مدرس بقسم النبات بكلية العلوم
جامعة الأزهر فرع البنات

Sexual Reproduction in Plants (Part.2)

التكاثر الجنسي في النباتات

(الجزء الثالث : الأزهار والنورات والثمار)

كتاب النظري والعملي

تأليف

د. إيمان عبد السميع علام

مدرس بكلية العلوم – فرع البنات – جامعة الأزهر

2020

Sexual Reproduction in Plants (Part.3)

GREEN BIO-NANOTECHNOLOGY

AND

PRODUCTION OF PHYTOCHEMICALS WITH ANTIBACTERIAL ACTIVITIES

AGAINST

THE CAUSATIVE AGENT OF TYPHOID FEVER

By
Dr. Eman A. Alam
Lecturer at the Botany Department,
Faculty of Science, Al-Azhar University,
Nasr City, Cairo, Egypt.

PHYTOCHEMICALS WITH POTENT ACTIVITIES AGAINST VECTOR-BORNE DISEASES (MOSQUITOES)

By

Dr. Eman A. Alam
Lecturer at the Botany Department,
Faculty of Science, Al-Azhar University,
Nasr City, Cairo, Egypt.

Phytochemical and Larvicidal Activity of some Extracts of some Egyptian Plants against *Culex quinquefasciatus* Say (Diptera: Culicidae) Larvae Collected from Zaria in Nigeria

Edited by:

Dr. Eman A. Alam

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Natural Phytochemical Products for Our Life

(Herbal Medicine from the Land to Our Hand)

By

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Lecturer at Botany Department, Faculty of Science,
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Plants between the Holy Quran and Modern Sciences

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Botany Department

Faculty of Science

Al-Azhar University (Girls Branch)

Pesticidal Activities of Some Natural Phytochemical Products

(Natural Phytochemical Nematicides)

Supervised by

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Presented by

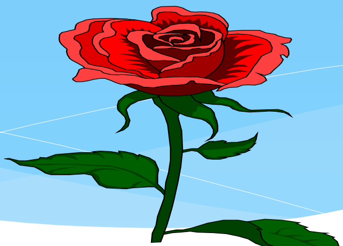
Aisha Muhammed

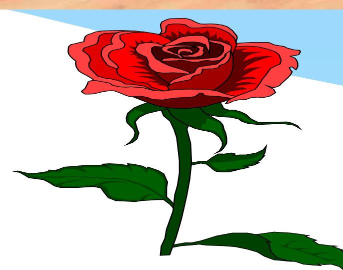
Amira Ezzat

Amira Saad

Mariam Ashraf

4th Year (Special Botany) for the Partial Fulfillment of the B.Sc. Degree than Five Hundreds Training Programs for Many Students at Different Levels of Education



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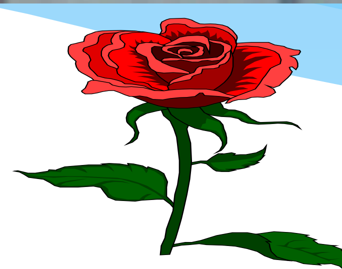
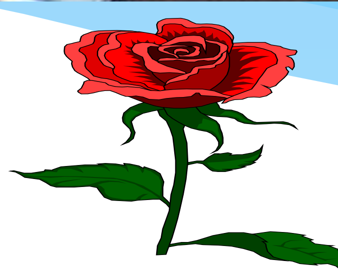



FAST
FURIOUS




Janumet
(sitagliptin/metformin, MSD)
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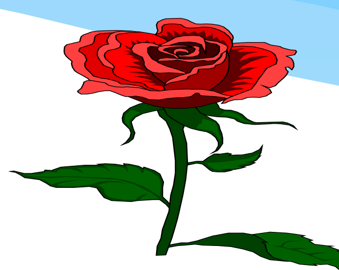
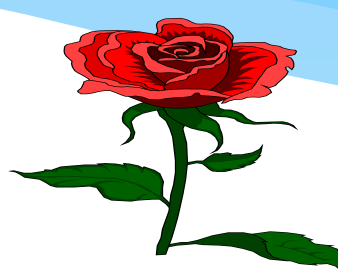
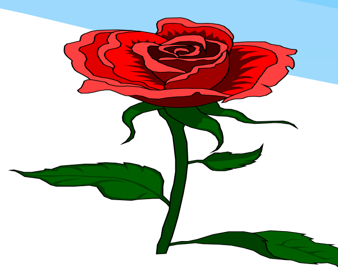
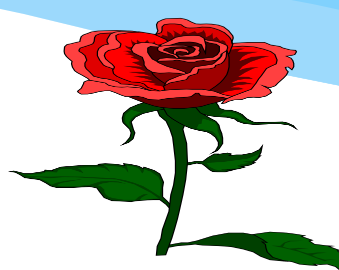





بالعلم هتبقى جنة
Dr.EMAN





Inquiry Based Science Education Workshop, Malaysia, Organized by UNISCO, October 2018

Thank You Very Much