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Susan S. Kilham and Robert J. Brulle
to Present Keynote Addresses on
Global Climate Change
at the 43rd Annual MACUB Conference
to be Hosted by Molloy College
Saturday, October 23, 2010

Susan S. Kilham, is a Professor of Biology and Environmental Science at Drexel University. Her research interests are aquatic ecology and climate change. She will co-address this keynote with Robert J. Brulle, a Professor of Environmental Policy and a Sociologist in the Department of Culture and Communication. He is well published regarding issues of global climate change.

Generally, scientists tend to hear the evidence about global warming and use the evidence to draw their own conclusions regarding the credibility of the concepts being discussed. However, most people, and most students at colleges, are not scientists; and most have grown up within a cultural context that basically treats all concepts, scientific and nonscientific, as debatable issues for which there are at least two respectable perspectives. This cultural approach leads most people to think of scientific findings as the beliefs of the presenting scientists instead of conclusions based on the overwhelming evidence. If the listener has a different personal belief regarding global warming, she/he is not likely to change that belief if she/he thinks she/he is listening to someone else's personal opinion. In this cultural context, facts become just another scientist's belief system, equal to anyone elses set of beliefs in terms of credibility. This cultural attitude may be based on a general ignorance of how the scientific method differs from personal opinion, and has much to do with why even extremely important scientific findings are not given the credibility and attention they deserve from policy-makers, who are elected by this same general public. Additionally, many scientists may not be aware of the magnitude of this problem. They simply don't understand how anyone can think of global warming as nonexistent or not important or, worse, a conspiracy of evil scientists.

Dr. Kilham will present the stark evidence on global climate change. Dr. Brulle will deal with the issue of scientific credibility in the U.S. and how scientists need to pay attention to this, when dealing with it in the classroom and when communicating with others.

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Articles can be submitted electronically to *invivo@mec.cuny.edu* or mailed as a printed copy (preferably with a diskette that contains the file) to the Editorial Board at Medgar Evers College. All submissions should be formatted double spaced with 1 inch margins. The title of the article, the full names of each author, their academic affiliations and addresses, and the name of the person to whom correspondence should be sent must be given. As a rule, full length articles should include a brief abstract and be divided into the following sections: introduction, materials and methods, results, discussion, acknowledgments and references. Reviews and short communications can be arranged differently. References should be identified in the text by using numerical superscripts in consecutive order. In the reference section, references should be arranged in the order that they appeared in the text using the following format: last name, initials., year of publication. title of article, journal volume number: page numbers. (eg. - [1]Hassan, M. and V. Herbert, 2000. Colon Cancer. *In Vivo* **32:** 3 - 8). For books the order should be last name, initial, year of publication, title of book in italics, publisher and city, and page number referred to. (eg. - Prosser, C.L., 1973. *Comparative Animal Physiology*, Saunders Co., Philadelphia, p 59.). Abbreviations and technical jargon should be avoided. Tables and figures should be submitted on separate pages with the desired locations in the text indicated in the margins.

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"Blue Genes," not Blue Jeans!
Incorporating the Ethical, Legal and Social Implications of the Human Genome Project into the Curriculum

by

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Abstract

Various aspects of the National Institute of Health-funded Ethical, Legal and Social Implications (ELSI) of the Human Genome Project (HGP) program have been incorporated into both biology and sociology courses at St. Francis College in Brooklyn, New York. A one-credit senior seminar for biology majors offered in the fall of 2004 titled "ELSI of the Human Genome Project" covered twelve topics that included eugenics, genes and behavior, the significance of race, and genetic enhancement and cloning. Many of these same topics were incorporated into the biology majors' genetics course. In addition, discussions revolving around topics such as genes and the environment that utilize monozygotic/dizygotic twin studies and consanguineous marriages were undertaken. A visiting scientist showed the students how computers could be used to enhance their understanding of genetic diseases. The students presented mock genetic counseling sessions as part of their final exam grade. Networking opportunities enhanced the learning of both the professors and the students. The genetics professor (Nolan) and the sociology professor (Mathur), who taught Sociology and the Family, swapped classes (they were coincidentally taught at the same time). Dr. Mathur provided input on the social implications of some genetic disorders such as Huntington's and Alzheimer's disease for the Genetics course. Dr. Nolan led a discussion about genes and behavior with the Sociology of the Family course. An outside speaker, an ethicist, delivered a lecture with a discussion to both classes titled: "Designer Genes". An honors course titled, "The Human Genome Project" was team-taught by Drs. Mathur and Nolan in 2007. The students have responded favorably to this interdisciplinary approach.

Introduction

The human genome has been sequenced[1,2]. However, what we now do with this information is paramount to our existence as an ethical people. Because of various issues such as genetic screening and DNA evidence that have only recently become evident and potential genetic discrimination, cloning and gene enhancement, the National Institute of Health decided to create a program in which groups could apply for funding to teach Ethical, Legal and Social Implications (ELSI) of the Human Genome Project (HGP). The Dartmouth College Ethics Institute applied for and received funding for such a program. Each year from 1997 through 2005 Dartmouth invited groups of up to twenty participants to attend a five-day program in which participants (interdisciplinary pairs) were presented with curricular materials to teach the material in their own institutions. These groups included lawyers, philosophers and sociologists, as well as scientists. The moderators of the ELSI-HGP course began with a discussion of the book "Mapping Fate" by Alice Wexler[3], who was at risk for Huntington's disease. She told a story about Huntington's disease and the hunt for the chromosome on which the gene for this disease is located. Alice's sister, Nancy Wexler, lead the hunt that determined on which chromosome the gene for Huntington's was located. A test is now available for Huntington's disease, which is a late-onset disease. It is an autosomal dominant disorder, which means that there is a fifty percent chance of getting the disease if one's parent has it. Since symptoms most often do not appear until after the reproductive age, the gene can be passed on before symptoms are displayed. These symptoms include involuntary muscle movements, slurred speech, and personality changes. The facilitators of the ELSI-HGP course began with the question of which issues are involved in studying Huntington's disease, and a list was generated on the board that included scientific, societal, legal, and ethical issues. These formed the framework for the five-day course, which included the topics that were eventually adapted for a course (see Table 1.) and that included the viewing and discussion of videos such as "GATTACA" and a mock trial using DNA evidence.

Senior Seminar for the Biology majors, Fall 2004 "Ethical, Legal, and Social Implications of the Human Genome Project

Our senior biology majors are required to take a Senior Seminar in Biology which is a one credit course.

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It rotates among the biology professors, who are free to choose their own themes for the course. To adapt the ELSI-HGP Dartmouth course to this thirteen-week, one hour a week format, we focused on the following topics in Table 1.

Since there were eighteen students in the course, and twelve weeks were available for student-lead sessions (Dr. Nolan taught the first hour by introducing the topic of the HGP), the students worked in teams to present their material and facilitate discussions. Index cards with the topics listed from the syllabus were placed in a hat and randomly chosen by students. The group pairs were asked to take opposing points of view.

Table 1. Course Outline for 1-Credit Biology Senior Seminar

Week	Topic
1	What is the Human Genome Project?
2	Eugenics
3	Screening for Genetic Defects
4	Breast cancer genes and their implications
5	Genetic discrimination
6	Genes and Behavior
7	Field trip to American Museum of Natural History (human populations)
8	Forensic DNA evidence---mock trial
9	Mock trial continued
10	Genes or the Environment?
11	Mapping Human History, Importance of race?
12	Genetic enhancement and cloning
13	Wrap-up and evaluation

For example, one student assigned to cover "genes and race" chose the papers with the point of view that there is no such thing as "race"[4, 5]. The other student on that team chose the papers that sided with the view that, "If we know the race of our patients we would be able to custom-design treatments"[6-8]. If the students were reluctant to participate, they would be required to each make at least one comment. There is controversy over whether race is important or not in differentiating genetic differences. Good summaries of the different opinions on the importance of race are given in these reviews[9,10].

A case scenario in which DNA evidence was included was presented to the students as part of a mock trial. We chose the prosecutor and the defendant, and the rest of the class participated as the jury. As was the case for the Dartmouth course, we had a hung jury. Some people just do not believe that DNA should be admissible as evidence. Future studies could be done to determine why people have this point of view, but we have conjectured that it is because DNA evidence is very abstract to most. Perhaps because of the proliferation of many crime shows on TV such as Law and Order, Criminal Minds and CSI, which now routinely use DNA as evidence, this opinion will change.

Some of the discussions in the seminar course became quite heated, especially on those topics that have to do with cloning and changing one's genetics. Most of the students took a more conservative "leave it alone/don't mess with Mother Nature" type of approach. Each student was also required to write a fifteen-page paper on their topic.

Genetics Course for Majors

Since taking the Dartmouth ELSI-HGP course, we have become more sensitive to incorporating ELSI-HGP issues into the Biology majors Genetics course. For example, the students initially read a New York Times article "Stem cell test tried on mice saves embryo"[11]. The author points out that there might be a way of harvesting stem cells from embryos that may satisfy ethical considerations of destroying embryos; one blastomere may be taken from an eight-cell embryo without destroying the embryo. This has previously been accomplished in pre-implantation genetic diagnosis (PIGD), which is a technique in which a blastomere is taken from an embryo in order to test the latter for defects. This blastomere can then be used as a stem cell. Since that development, four genes have been inserted in mouse adult fibroblast cells, which induced these cells to become pluripotent[12]. Since then, there has been an avalanche of research on induced pluripotent stem cells (iPS), but we have been cautioned that research still needs to be conducted on embryonic stem cells (ES)[13]. Today, the ethics of stem cell research continues to be debated. The House of Representatives most recently passed the H.R. 3 Act "To amend the Public Health Service Act to provide for human embryonic stem cell research" 253 to 174 on January 11, 2007. This was an attempt to end the

Bush administration moratorium on developing new lines of stem cells. However, this act was vetoed twice by President George W. Bush. However, on March 9, 2009 this ban was lifted when President Obama signed the Stem Cell Executive Order and Scientific Integrity Presidential Memorandum[14] which now allows for federal funding of embryonic stem cell research.

Other topics that have been incorporated into the biology majors' genetics course include eugenics, genes and race, the HapMap project, the selective advantage of some genes, genes versus the environment, and consanguineous marriages. Some overlap has occurred with topics covered in the senior seminar, but many new references and ideas have been added.

Eugenics

Eugenics focuses on encouraging only the "fittest" to reproduce, is discussed[15-19]. The students are quite astounded by this topic, and are quite surprised to hear that eugenics was looked upon quite favorably in this country before Nazi Germany came to power. Articles chosen included those that explain the definition and history of eugenics**,** the relation between eugenics and the Holocaust, and some modern-day interpretations of eugenics, such as the issue of abortion. Photos are shown to the students that show that the idea of eugenics promoted "Fitter Family" contests[20]. (See Figure 1).

Figure 1. Fitter Family Contest

(Image ID: 14) Title: Kansas State Free Fair, Topeka, Fitter Families Contest examining staff and "sweepstakes" winning family; Archival Information: AES,Am3,575.06,55 http://www.eugenicsarchive.org/eugenics/list2.pl

The HapMap Project

The HapMap Project ("hap" is short for "haplotype" or a DNA sequence that contains a single nucleotide polymorphism or SNP) seeks to relate people by DNA "haplotypes". The principal investigators of this project are from Japan, the United Kingdom, Canada, China, Nigeria, and the United States. Initially, people from Nigeria, Japan, China and the US (northern and western European ancestry) were genotyped[21,22]. The current goal is to use information on differences to target customized treatments for disease[23,24]. These researchers offer some fresh insights on recent HapMap developments derived by testing other populations, such as residents of Mexico. Additional markers, such as the Y chromosome, are also being studied in the Mormon population from Utah[25]. The HapMap web-site chronicles the history of this project and contains many references[26] (http://hapmap.org)

Genes and Race

Besides articles listed in the Senior Seminar portion of this paper, an additional article that alluded to race was discussed in the biology majors genetics course. This paper provided data that showed that genes for pigmentation are similar in both fish and humans[27]. An inference to draw from this finding would be that pigmentation should not be used as a criterion to discriminate as the gene for melanin is present across the animal kingdom. This article content also is tied into a unit on genes and development, which showed how the DNA sequence of many essential genes is the same or similar across species.

We dissect out information and define frequencies, alleles, genotypes, insulin resistance, diabetes, the importance of converting data to percentages, and the utility of statistical tests and probabilities, as contained in the excerpt below[28].

"In our preliminary assessment of the PC-1 genotype in 301 healthy children, a striking black-white difference in Q allele frequencies was identified, with the QQ genotype occurring in 63% (86 of 137) of black children versus 3% (5 of 164) in white children. Conversely, the KK genotype occurred in 74% (121 of 164) of white children versus 4% (5 of 137) in black children. The racial difference in the prevalence of these genotypes was highly significant by Fisher's exact test. This finding was intriguing, given the racial/ethnic differences in insulin in children and the high prevalence of insulin resistance (IR) in type 2 diabetes in adults."

Selective Advantage of Some Genes

In a genetics course, the students learn about examples that show the selective advantage of having certain genes, such as the blue-throated lizards (See Figure 2, which gave us the idea for the title of this article). The lizards with the blue genes survive longer than those without these genes, possibly because the blue color attracts more mates[29].

One of the most frequently used case studies in humans to illustrate the selective advantage that a gene can confer is the sickling gene. This gene evolved in the same geographic areas where malaria evolved, and thus is found in a higher frequency in groups where malaria occurs (in the Mediterranean region and Africa). Since people that are carriers (have only one copy) of the sickling allele are more resistant to malaria than those that do not have this allele they are said to have a heterozygotic advantage. However, inheriting two copies of this recessive allele, leads to an increased sickling of the red blood cells, which can be fatal. Jones[30] predicts that with the eradication of malaria, the sickle cell allele would become eliminated with time, as two copies would no longer be advantageous to the population.

Figure 2. Blue genes. "In side-blotched lizards, three throat colors correlate with strikingly different behavior in the males. Scientists discovered that genetics underpins the self-sacrificing behavior of the blue-throats. Examples of an orange, blue, and blue-yellow cross are shown." (Sinervo et al. 2006). Credit: *Suzanne Millls and Barry Sinervo*

Genes and the Environment--Monozygotic and Dizygotic Twin Studies

A question we all share is whether our similarities and differences are genetic or influenced by our environment. We are fascinated by twin and sibling studies that attempt to tease out which components of our lives are which. There have been many studies of different attributes shared (or not shared) by monozygotic twins separated at birth, or reared together, on siblings that are not twins, and other cohorts of children to try to gain information about this topic. We are careful to point out to our students that it would be unethical to separate these twins at birth, and that many separations occur as the result of adoption. The concept of a heritability index, which is expressed as a percentage of traits shared that are believed to be caused by genes is broached. Each student in the genetics class is then asked to summarize and present their summary to the class from information they gleaned from a study that they researched on the Internet or from sources we have provided [31-38].

Consanguineous Marriages

A topic that piqued everyone's interest and created further discussion was the concept of consanguineous marriages, which, although probably foreign to most Americans, is common in other groups. Through pedigree analysis, we revealed that there is an increased chance of passing on double deleterious genes when first cousins marry and have children. An article from the New York Science Times[39] that illustrated the increase in genetic disorders among children of Israeli Bedouins was discussed. Upon further research we have devised a bibliography of papers to select from for the students to read and discuss[40-53].

The issue of consanguineous marriages is appropriate for both a genetics course and the Sociology of the Family course because it spans both genetics and social customs.

Questions For the Students Include:

What are the marrying customs of this community?

Why did these customs evolve?

What are advantages and disadvantages to these customs?

If you were to construct a family tree of several people in this community, what would the probability of children of a union between first cousins be of obtaining a certain genetic trait/ disorder?

Why would someone want to hide their genetic history?

How would you feel if you were a couple in which both of you carried a deleterious gene (allele)?

How would you feel if you were a child of such a union?

Another possibility for a unit on this topic would be for the students to act out how a couple, children, and the village would behave upon learning that these genes were present in the couple. An alternative to the above would be to have the students produce PowerPoint presentations depicting a map of the region, some pictures of the characteristic people of the region, and some information about their customs.

Mock Genetic Counseling Sessions with Posters

The names of genetic diseases (Huntington's, Down syndrome, Duchene's Muscular Dystrophy, Sickle Cell Anemia, Marie-Charcot Tooth Syndrome, Marfan's Syndrome, Prader-Willis Syndrome, Tay Sachs, Fabry's disease,…) were written twice on two sets of index cards. One set was labeled "client" and the other was labeled "counselor". The students picked a card out of a hat and thus were paired for their presentation. It was required that each pair conducts a mock counseling session in front of the class. They also designed a poster that contained a pedigree depicting how the disease was inherited, and some general information about the disease, The class was required to take notes, as there were fifteen multiple choice questions about the disorders on the final. This project was well-received, and was scheduled for the last three classes or the last lab period. Videotaping of the students was added in subsequent semesters.

Computer Workshop on Finding Genes

Steve Pechous, Ph.D. from the National Center for Biotechnology and Informatics (NCBI) came to Saint Francis College from Washington, D.C. to deliver a three hour workshop on finding and learning about genes using their website. As DNA codes for protein, we first start with the linear DNA sequence. Each of the twenty amino acids, which are the building blocks of protein, has a three letter DNA code. Although the DNA sequence is read in a left to right fashion, the amino acid chain, or polypeptide chain, that is produced as a result of the DNA transcription, can fold into three dimensional shapes. In Dr. Pechous' workshop, we would select a linear DNA sequence and see how it became transformed into a three dimensional shape that could be rotated. Each part or domain of the molecule were displayed in a different color. One of the proteins we examined, along with its different forms, was hemoglobin, which is the pigment that makes blood red. Dr. Pechous is available to give workshops to schools free of charge.

Networking Opportunities

The ELSI course made us more aware of issues outside the typical genetics and sociology course material and thus we were able to explore networking opportunities with professors and other professionals both at St. Francis College and elsewhere. We have decided to network with Uwe Gielen, a psychology professor and the founder and Director of the Cross-Cultural Institute of Psychology at St. Francis College. He organizes lectures and symposia every year based on various cross-cultural themes.

Dr. Gielen hosted a symposium titled: "Cultural Aspects of Genes and Race" in the fall of 2004. He invited a guest speaker, Jefferson Fish, Ph.D. from St. Johns University, to deliver an interactive lecture, "Scientific Basis of Race." Dr. Fish, also a psychology professor, stated in his opening remarks, "Your race changes every time you get on an airplane". Dr. Fish, who is Jewish, is married to a Brazilian who would be classified as "Negro" by many Americans. Dr. Fish showed us that people could be "classified" in many ways, including blood types.

Dr. Gielen invited Dr. Nolan to give the introduction for the public showing of the movie: "The Faces of Eve" in which she described the use of mitochondrial DNA to trace ancestry. By looking at various mitochondrial DNA genotypes, scientists have been able to infer that our original ancestors came from Africa from a small gene pool.

Networking was further enhanced when Dr. Fish agreed to be a guest speaker at the Columbia University Seminar in Population

Biology, in the spring of 2005. His talk was titled: "Biological Basis of Race." He added to some of the information he had presented at SFC, and noted that Caucasians originated in Russia, and they were shunned by other groups that were "whiter" than they were. The Columbia Seminar in Population Biology (Dr. Nolan is a co-chair) has been the vehicle for presenting information to students about other genetic issues that affect populations.

We have continued to invite speakers to the Genetics class, such as Dr. Richard Borowsky from New York University who lectured to the students about blind cave fish and their hybridization with surface seeing fish.

"Swap a Professor" Day

Professor Mathur discussed the effects of genetics diseases such as Huntington's disease on the family with the Genetics class and Professor Nolan discussed genes and behavior with the Sociology of the Family class. Just as we had done in our ELSI class at Dartmouth, we made a list of Nature and Nurture on the blackboard, and listed all the attributes of humans under each. The students were also very curious about whether or not there was a gene(s) for homosexuality. The students viewed a PowerPoint presentation that was obtained from the Internet and designed by Dr. Hamer that was based on his research[54]. The students wanted to know more about other genes that control behavior, and were somewhat skeptical of the validity of an actual gene for high risk behavior,

Guest Speaker Eileen McGee - "Designer Children"

New York State has a program titled "New York Council for the Humanities" in which non-profit groups may arrange to have a speaker from a selected list come to their organization. Dr. Eileen McGee was a speaker that we arranged to come to our joint classes. Dr. McGee, a bioethicist, who holds a Ph.D. in Philosophy, delivered a PowerPoint presentation about reproductive technology in this country to both the Genetics and Sociology of the Family classes. The students were quiet initially, but became more vocal when Dr. McGee broached the topic of choosing to abort for a specific reason. She informed us that the law states it is legal to have an abortion for ANY reason, so why not for a specific choice? The students erroneously felt that she was taking the sides of who we'll call the "Specific Choice Abortionists" (The Chosen Abortions). One young lady, after being regaled of statistics on infertility, *in vitro* fertilization (IVF), pre-implantation genetic diagnosis (PIGD), costs, etc., felt that "If a woman is lucky enough to get pregnant using these assisted techniques, she should just accept what she gets." Dr. McGee responded: "Would you be willing to tell a friend that?" to which the student responded with an emphatic, "Of course!" Another student, (this talk came on the heels of St. Patrick's Day!) said "A fetus or a child is not like an Irish soda bread that turns out bad---you can't just throw it away!" McGee told us that one U.S. man had been traced to have fathered over 100 children, through a sperm bank, and asked us what we thought the implications of that would be. She noted that England has a legal limit of fathering 10 children, and France, five, through their sperm banks.

Honors Course - Genes and You

This interdisciplinary course met with a small group of students once a week for three hours and was team-taught by Dr. Mathur and Nolan. Thus the students benefited from obtaining a sociological as well as scientific perspective. There was a great emphasis on the former, as there was only one science major in the course.

One of the first topics of interest was genetic enhancement[55]. We discussed the pros and cons, and focused mostly on the athletic perspective, or "gene doping"[56]. Recent articles have also focused on pre-natal choices[57-59]. An interesting idea to try would be to have the students write a letter to an unborn fetus[60]. They could justify the reasons why they had picked enhancement for the child and the benefits it would bring, or state why they chose not to use enhancements.

The weekly three-hour format of this class allowed the students in this course to view the DVD GATTACA[61]. This film presents a futuristic scenario where people are identified as workers in a space station by their DNA. One "less than perfect" aspiring astronaut was able to "fool" the system by adapting another's "perfect" identity. This movie sparked a lively discussion of what DNA could mean to us in the not-so-distant future.

An article of great interest to the students was about pre-implantation genetic diagnosis[62]. This topic involves plucking cells from embryos that have been produced, usually through IVF methods. Many ethical issues arose and were discussed, including the fate of un-used embryos.

Additional articles that should provoke discussion include in references 63 and 64.

Current controversies of stem cell genetics were also explored. A discussion of the ethics of the use of fetal tissue from abortions for stem cell research was especially controversial. An outline of this topic can be found in[65]. A field trip to the Hall of Human Origins at the American Museum of Natural History was also conducted in which students were required to list genetic similarities and differences between humans and other primates. Some of the topics listed above such as genes and race, and genes and the environment were also covered in the honors course.

Conclusions

Since we have taken the ELSI-HGP course at Dartmouth in 2003, much has happened in the field of genetics. Craig Venter has now sequenced his own DNA[66], President Obama has approved expanding stem cell research, discussions on what to do with unwanted embryos have emerged and talk of DNA as evidence are now common-place. The *Genetic* Information Nondiscrimination Act (GINA) was passed in 2008[67]. It has been noted[68] that GINA has flaws that need to be addressed such as the fact that health insurance companies cannot legally raise premiums based on genetic risk or genotype, but they can raise rates based on phenotypes. Discussions could compel students to think about the morality of these legal and societal issues. Students need to become informed about legislation dealing with genetic testing also. There has been a proliferation of genetic tests available over the Internet ranging from testing a propensity towards Alzheimer's disease to ancestry[69]. Figure 3 shows a map which depicts those laws for Direct-to-consumer availability are different for each state. The American Medical College states that consumers need to be informed of the meaning of results of genetic tests[70]. Fifteen states have passed regulations regarding human cloning; there has been no unified federal mandate[71].

We realize that we cannot teach science in a vacuum, and that the ELSI-HGP issues are very significant. We must continue to present these current issues as well as a forum of discussion for our students, who will be making decisions on these matters in the near future as, hopefully, engaged and involved citizens. Additional ideas for incorporating ELSI-HGP into the curriculum can be found in a compilation of many of the ideas covered in the course[72] and in a short guide to understanding the HGP[73].

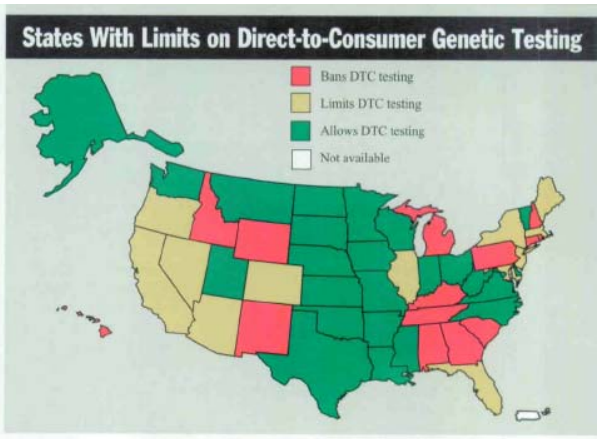

Figure 3. Direct-to-consumer Availability of Genetic Tests.

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Differentiated Instruction to Teach Climate Change to Non-Science Majors

by

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Abstract

This article includes inquiry-based strategies to help non-science majors learn science content and skills in multiple ways. Specific tools and techniques of active and collaborative learning used in a non-science majors' class at Nassau Community College to teach photosynthesis and respiration are discussed. In a differentiated classroom, the modified pedagogy, along with diverse modes of delivery of course content, allows students to work with their strengths and improve upon their challenges. Utilizing a variety of learning styles and administering non-traditional assessment tools allowed students to apply biological concepts in real life situations, prepare PowerPoint presentations, debate social issues, and enhance critical thinking and information management skills while learning about climate change.

Introduction

Differentiated instruction has recently gained a considerable amount of attention and momentum among educators seeking to address the needs of a heterogeneous student population. All innovative approaches hold that students learn better when they are engaged in the learning process. Not all students can be engaged with the traditional mode of lecture in a classroom, especially in today's more interactive world. Students learn better when they can relate course concepts to real-life applications. We expect the next generation of students to possess a balance of content and skills with competency in critical thinking, information management, and communication. Differentiated instruction applies an approach to teaching and learning so that students have multiple options for taking in information and making sense of ideas[1]. Many studies emphasize brain-based learning and urge educators to strengthen the classification of multiple intelligences as proposed by Howard Gardner[2-4]. Educators at all levels are now recognizing that the banking concept of depositing content does not help to keep students engaged in the learning process[5]. For the last two decades, biology educators have adopted many pedagogical modifications, in addition to hands-on activities to enhance student learning. Some of these modifications include the use of projects and presentations[6, 7], collaborative learning[8, 9], working with case studies[10,11], using computer simulations[12,13], or working with course portfolios[14].

This article includes instructional strategies, tools, and techniques of education in which students can be engaged in learning course concepts and research of important applied topics; involved in deductive/logical reasoning; conduct PowerPoint presentations; and participate in healthy debates. This modified pedagogy can be used to help students learn any biological concept but this article deals with the understanding of photosynthesis and respiration processes and sustainability of the environment. The learning process implemented is active, constructive, and reflective. In addition to changes in teaching and learning philosophy, pedagogical modifications need gradual adoption of specialized learning tools. With the constraints of a 15-week semester, a blueprint illustrating open-ended sessions showing many possibilities of change should always be shared with students at the beginning of the semester.

Dunn and Dunn Learning Style Model describes how some students do not enjoy active learning or cooperative exercises. These analytical learners want a quiet, independent space to process information, compared to global learners who are not readers and respond better to visuals, discussions, and group work[15]. Schader et al.[16] developed an assessment tool called "My Learning Print" to gather information about the interests, abilities, experiences, and learning preferences of students. Understanding

characteristics of a global and analytical learner[17] helps to tailor the style of instruction. Many liberal arts students in community colleges may take only one laboratory science course. These students often find the chemistry section of an introductory course to be most challenging. Connecting photosynthesis and respiration with climate change can motivate students to explore details of the chemical processes and enhance their scientific literacy to be informed citizen.

Instructor Preparation

Course policy should clearly highlight the student's responsibility in learning by completing homework, conducting research, and submitting assignments on time. The pre-test could include simple questions about basic concepts of biology and a survey of student learning styles. Either you can provide some options or ask students how they learn best. Some of the options may include: in a quiet place, with music or computer, in the library, in study group, by asking questions, by answering questions, and others. Students should also be reminded to work on their non-preferred styles in groups or with extra help. Formative assessment can be done using concept mapping, information mapping, Venn diagrams, one-line journal entries, double-entry journal entries, summarizing, and others.

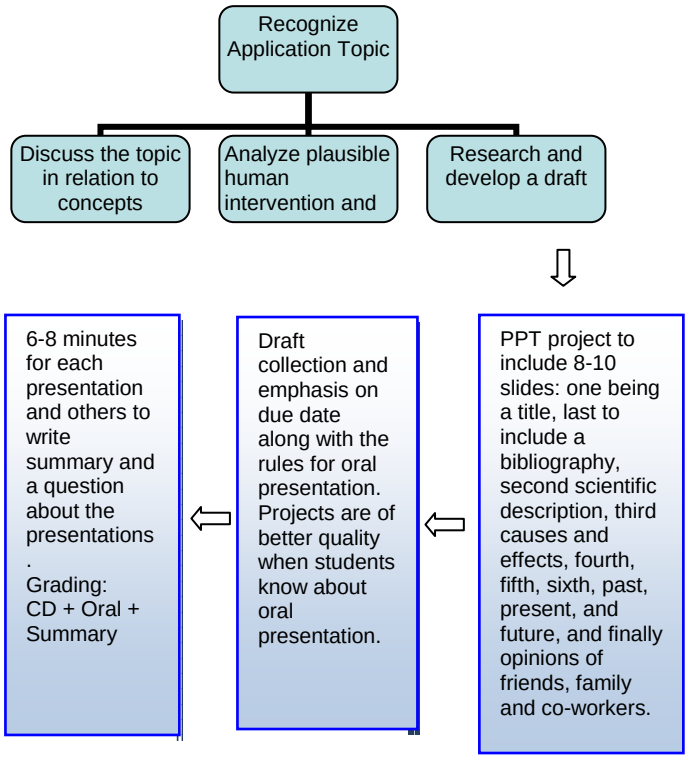
In addition to an in-class examination, evaluation for this section of the course may include a PowerPoint presentation. At the beginning of the class session, students may be provided an article to read and analyze or a trigger case with a message about climate change. Many lesson plans and research articles are available at the websites listed in Appendix A. The article or a case can be used to jumpstart the topic and choose some aspect of climate change to research and prepare the PowerPoint presentation. Fair grading with the same benchmarks for all students can be achieved by using a rubric that encompasses all the expected tasks.

Appendix A

Based on the learning objectives, a rubric can be created and shared with students to use as a self-assessment tool. Instructors can retrieve different types of rubric by searching "rubric builder" online. Prior to the day of lecture on photosynthesis, students can be asked to bring a homework assignment to class. The homework may include definitions or descriptions of twenty scientific terms. Using vocabulary provided by the students, instructor can generate basic conceptual understanding of photosynthesis and respiration. Teaching photosynthesis and respiration, along with developing information management skills, requires four class sessions of hour and fifteen minutes each. Students also conducted numerous hands-on activities to investigate photosynthesis and respiration for three hours during a laboratory session.

Procedure

Part I: Summary of the project designing process includes:



Topics in an introductory biology course at NCC include: melting icecaps, changing weather patterns, extinction of bees, future of polar bears and chin-striped penguins, wild fires, natural disasters, human diseases, bees & pollination, agriculture & food, non-biodegradable products, conservation of natural resources, thermocline, use of aerosol, replacing spray with gel, Styrofoam use, recycling, energy crisis, alternative energy, hybrid cars, economic impact, green energy, solar panels, car pooling, use of electric appliances, and others.

Part II: Parallel to the discussion on Projects, students should work actively to generate concepts during discussion sessions (may include short lectures followed by activities):

Observations

Review of terms and concepts by developing questions and playing Jeopardy – includes information mapping of photosynthesis, bookkeeping for ATP production from aerobic cellular respiration, Venn diagram to compare the processes.

Table 1: Information Mapping of Photosynthesis (student groups may be given tables)

Structure	Composition	Reaction	Products
Granum	Stacks of thylakoid filled with chlorophyll	Light-dependent reaction I and II	Oxygen, water, energized electrons, and NADPH
Thylakoid membrane	Electron acceptors and ATP synthase	Electron Transport Chain	ATP molecules (Photophosphorylation)
Stroma	A fluid filled space in between thylakoid	Carbon fixation, carbon reduction, and regeneration of RUBP	C3 + C3 → C6

Table 2: Calculating ATP during Aerobic Cellular Respiration

Process	NADH	$FADH_2$	ATP	Total ATP (including conversion)
Glycolysis				
Transition Reaction				
Citric Acid Cycle				
Total				=

Figure 1.

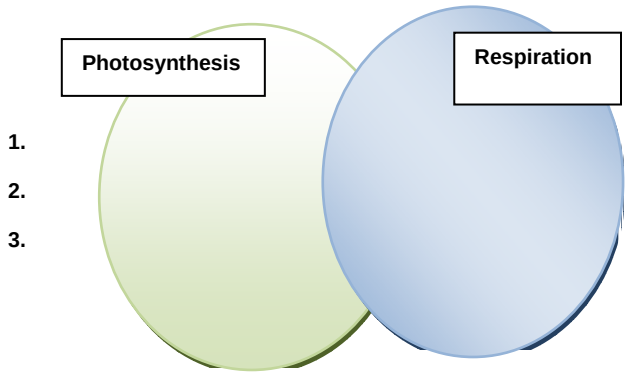


Figure 1. Write three features specific to photosynthesis, three to respiration, and three common features in the overlapping zone of the Venn diagram.

1. Students in an introductory biology course for non-science majors at NCC assumed either a cooperative or competitive mode; they were allowed to use their textbooks during class activities. Global students looked at the diagrams and helped their team. On the other hand, analytical students looked at the glossary and provided answers.
2. Students who previously did not participate in the class discussion became active and helped their teams to receive bonus points. Although the class policy does not require students to bring books, but since they are aware that there maybe a group activity or *Jeopardy* using the text, most of them always had their textbook with them.
3. PowerPoint projects were discussed during every class session and students were reminded to follow the guideline coversheet (self-assessment tool) to earn full points.
4. One class session prior to lecture exam was spent as a PowerPoint Presentation Class. Students brought CDs or flash drives as digital submissions of their presentation.
5. Students provided short response questions from their *Jeopardy* Review, which was used as a pool along with a multiple choice question section during the in-class exam. This ensured the accountability and validity of learning of concepts related to photosynthesis and respiration.

Discussion and Implications

Implementing these pedagogical modifications with numerous hands-on activities engaging students to enhance various skills resulted in better participation and academic achievement. Results indicated that actively-participating students enjoyed group work, completed assignments on time, gained confidence about their learning capabilities, and performed above their expectations on exams. This challenging section of non-majors biology dealing with the chemistry of photosynthesis and respiration became a popular topic of discussion after group work. The required guided inquiry resulted in learning by processing the information rather than rote memorization of the content. Most students submitted their PPT on the due date, some of them before the date if they were not able to attend the class on the presentation day. Students earned full credits if they completed all sections (CD + oral + summary), but received only partial

credit if they attended the presentation session and wrote a summary of all the presentations. Questions recorded during the oral presentation section were discussed. Many of these questions led to other issues regarding what we should do to prevent destruction to our environment. Demonstration of acquired scientific literacy was evident when students discussed ideas such as (a) giving gifts without wasting paper, (b) raising advocacy in their towns, (c) planting kitchen gardens, (d) car pooling, (e) buying energy saving appliances, (f) buying hybrid cars, and (g) civic duties. A student brought a DVD to a class and showed a clip of the Al Gore's movie "An Inconvenient Truth" to make a point during her presentation. This was the first time I witnessed students getting excited and involved in politics as they discussed social and political perspectives, particularly the debate surrounding the Kyoto Treaty, of global warming with the proper scientific understanding. They reported problems in their communities and proposed solutions, and discussed their possibilities similar to what Goran and Braude[11] reported about learning of social perspectives through group work. Most students acknowledged that less than 20% of their friends or families ever discuss climate change or global warming. Only one returning student in this class presented a skeptical approach regarding climate change, arguing that such change has occurred throughout history without human intervention. He presented research and evidence, but it was amazing to observe how other students argued and questioned the validity of his report with their data and sources to provide contrary evidence of a faster rate of climate change due to human intervention. Satellite pictures of melting ice at North Pole or South Pole were the most popular visuals in almost every report. Students realized connections between what they learn and how it affects them in everyday life, and felt empowered with the ability to better interpret the future of the planet. I witnessed a positive change in their attitude toward learning as a result of this activity.

At the beginning, many students were not motivated but suddenly became very active in discussing economic, social, political issues surrounding global warming. This new interest in the topic helped these students perform better on quizzes and exams, and kept them active in other topics which followed. Students' academic achievement improved overall and their interest in learning showed a dramatic curve in the positive direction. They realized their responsibility to meet expectations during the in-class exam (summative assessment). When students are grouped with their strengths to explore the issues, to communicate, record, and manage, they work as a team to succeed and gradually work on their challenges. Armstrong[18] described intrapersonal intelligence to include moods, motivation, desires, and the capacity for self-discipline, self-understanding, and self-esteem. Inquiry-based students' preferred activities provide opportunities to sharpen problem-solving, communicative, interpersonal, intrapersonal, information management skills and help students become better learners. Students certainly learn more when we facilitate learning rather than pouring the content on them to finish the course[19].

Similar to the experiences of other educators, I encountered a considerable amount of resistance while implementing active/collaborative activities or involving students in research and oral presentations. The student's responsibility was explained in the first class and the importance of portfolio-based assessment for their final grade. It may not result in the best grades for all students, but such an environment fosters the scientific literacy of liberal arts students in order to help them make better decisions. Once students are motivated by learning through their preferred styles, they become engaged in the content and utilize all the tools, techniques, and styles of learning. It helps student to adapt at processing information both globally and analytically[20]. By the end of the semester, global learners took pride in their intrapersonal intelligence in addition to their strong interpersonal intelligence and vice versa for analytical learners. As Dr. Leshner[21], CEO of the American Association for the Advancement of Science, argues, "science literacy is, after all, no longer merely a luxury for the gifted and wealthy, but in fact a baseline requirement for any student hoping to compete for jobs in the 21st century."

In my experience, our students are willing to participate actively in the process of making this planet better for tomorrow, but we need to have meaningful ways of engaging them in this endeavor.

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Some useful web sources include:
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http://www.ucar.edu/learn/141.htm;
http://www.exploratorium.edu/climate/index.html;
http://www.earthinstitute.columbia.edu/grocc/;
http://ccrc.unh.edu/
http://hdgc.epp.cmu.edu/teachersguide/teachersguide.htm
http://wupcenter.mtu.edu/education/Global_Climate_Change/lesson_plans.htm

Fetal Hemoglobin and Age of Red Blood Cells in Fowl

by

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Abstract

Electrophoresis was performed on hemoglobins of chickens and ducks. Fetal hemoglobins of chickens disappear after their 31st day after hatching and those of ducks after their 47th day after hatching. The length of time for these disappearances may be an accurate measure of the life span of their red blood cells.

Key words: chickens, ducks, red blood cells, hemoglobin, electrophoresis

Introduction

A study of the hemoglobin patterns of chickens and ducks in the first eight weeks of their lives was made. In both adult chickens and ducks there are two hemoglobin bands (Hbl and HbII)[1]. Additional hemoglobins occur in developing embryos of both species[1]. One type of embryonic hemoglobin, referred to here as HbF (fetal hemoglobin), persists in the young of some fowl after hatching for several weeks. The length of time for the disappearance of HbF from the time of hatching was also examined. Observation of the time (days) for the disappearance of HbF for chickens and ducks can provide an estimate of the life span of their red blood cells (rbc's).

Several different methods have been used to estimate the average life span of red blood cells in vertebrates. Most of these methods can be put into two general classes: those which "tag" the cells as they are being formed, and those which attempt to tag proportionately the cells of all ages found in the vascular system[2]. Both methods are intrusive, and involve the use of radioactive materials injected into the test animals. The approach in this study utilizes fetal hemoglobin as a natural marker. It assumes that HbF production ceases upon hatching, and that rbc's containing this hemoglobin disappear over a defined period of time. The disappearance of HbF was examined by electrophoresis of blood samples from the two species.

Materials and Methods

Hatching eggs for chickens, *Gallus gallus,* and Rouen and Pekin ducks, both *Anas platyrhynchos,* were obtained from breeder farms and hatched in a laboratory incubator. In addition, 28 two-day-old chicks, including five breeds (White Leghorns, Red Leghorns, Minorcas, Blue Andalusians, and Anconas), were obtained from a commercial hatchery. Birds were maintained in laboratory facilities, kept on the floor for two weeks, then moved to wire bottom cages for the duration of the study. The birds had constant access to feed (a commercial starter mash, then starter crumbles) and water.

Blood was obtained from a pre-hatchling duck (a Rouen) during its 27th day of incubation. After hatching, blood was obtained from the birds' right ulnar artery at varying intervals until the 28th day, when the frequency of blood collection was made daily for the chickens, and daily for the ducks after the 39th day. The increase in sampling was based upon the response of the fetal hemoglobin die-away between the 27th and 37th day to 0.0 percent by the response of a single chicken (Rhode Island Red), and the 42nd and 45th day by a single duck (Rouen). Not every bird was bled. Approximately 20 ul of blood was collected in nonheparinized microcapillary tubes. The blood was centrifuged for six minutes at 5,000 rpm.

The rbc's were separated from the plasma, diluted with deionized water (five parts deionized water to one part blood), and both rbc's and plasma frozen until electrophoresed, usually performed on the same day of collection.

Protein fractions of the hemolyzed rbc's were resolved using agarose gel electrophoresis (Titan Gel High Resolution Protein System, Cat. No. 3040, Helena Laboratories, Beaumont, Texas). Electrophoresis was conducted at pH 8.7 for 24 to 34 minutes at 250-260 volts, and five to 15 amps. The patterns were stained with Coomassie Brilliant Blue. Percents of the bands within the pattern's curves were obtained by analysis using an imaging densitometer (Bio-Rad Quantity One Version 4.6.3).

Results

Initial data for a single chicken (Rhode Island red) indicated that HbF disappears between the 27th and 37th day (Table 1). For a single duck (Rouen) on its 45th day of life 0.7 percent HbF was present (Table 2). Subsequently, for the larger group of chickens, 0.1 percent HbF was present on their 31st day of life, and none present on their 32nd day (Table 3). HbF for ducks (white Pekins) on their 47th day of life indicated the presence of 0.8 percent, and no HbF on their 48th day (Table 4).

A comparison of a 16 day old chick with three hemoglobin peaks with a 37 day old chick with two peaks is shown in Fig. 1a,b. For ducks, a comparison of 22 and 50 day old duck illustrates the change from three hemoglobin peaks to two peaks (Fig. 2a,b). The single pre-hatchling blood sample analysis yielded 16.6 percent HbF, the highest value for this hemoglobin in the study. The percent increases in the adult hemoglobins, HbI and HbII, as HbF declined were similar for chickens. In ducks, HbI showed a steady increase while HbII remained almost unchanged. Fetal hemoglobins in both chickens and ducks were cathodic, whereas HbI and HbII were anodic in both species (Fig. 1, 2). A total of 96 patterns were made for chickens, and 102 patterns for ducks during the study.

Table 1. Hemoglobin Percents for a Rhode Island Red (chicken)

Day	HbFetal	HbI	HbII
1	8.6	61.7	29.7
12	10.1	57.5	32.4
20	4.6	56.3	39.1
27	3.2	58.7	38.1
37	0	67.1	32.9

Table 2. Hemoglobin Percents for a Rouen Duck

Day	HbFetal	HbI	HbII
Prehatch	16.6	58.7	24.7
7	8.2	54.5	37.3
15	10.1	56.7	33.2
22	10.4	53.1	36.5
32	4.7	72.1	23.2
37	5.5	55.2	39.3
39	4.7	58.4	36.9
40	2.8	62.5	34.7
42	2.5	63.1	34.4
45	0.7	69.4	29.9

Table 3. Average Hemoglobin Percents for Five Chicken Breeds

Day	HbFetal	HbI	HbII	
8	8.5	55.6	35.9	*
16	4.5	54.6	40.9	*
20	3.6	58.3	38.1	*
23	3.3	58.6	38.1	**
26	4.2	54.9	40.9	**
28	3.6	57.6	38.8	**
29	1.1	59.8	39.1	****
30	1.5	58.3	40.2	***
31	0.1	61.7	38.2	****
32	0	63.3	36.7	****
34	0	61.1	38.9	****

*=2 obs, **=3 obs, ***=4 obs, ****=6 obs

Table 4. Average Hemoglobin Percents for Pekin ducks

Day	HbFetal	HbI	HbII	
10	10.8	53.9	35.3	*
16	10.8	55.1	34.1	**
22	10.6	54.8	34.6	**
30	7.7	52.7	39.6	**
35	5.5	63.8	30.7	**
38	4.6	59.8	35.8	**
39	4.7	59.6	35.7	**
40	3.4	58.8	37.8	**
41	4.4	64.9	30.7	***
42	1.2	58.7	40.1	**
43	3.2	56.7	40.1	**
44	3.9	59.4	36.7	**
45	1.9	60.9	37.2	***
46	3.3	57.9	38.8	***
47	0.8	65.7	33.5	****
48	0	58.8	41.2	****
50	0	63.1	36.9	****

*=2 obs, **=3 obs, ***=4 obs, ****=6 obs

Discussion

Using different methods, the red cell life span of chickens has been estimated as a maximum of 35 days[3] to 28 days[4]. The values obtained in the present study compare most closely to the latter study. Average values for the mean red cell life span of ducks was 42 days[3,5]. The value obtained in the current study was 47 days, nine percent higher than those reported elsewhere.

Utilizing the disappearance of fetal hemoglobin is a different approach to determining the life span of rbc's. This requires the exact date,

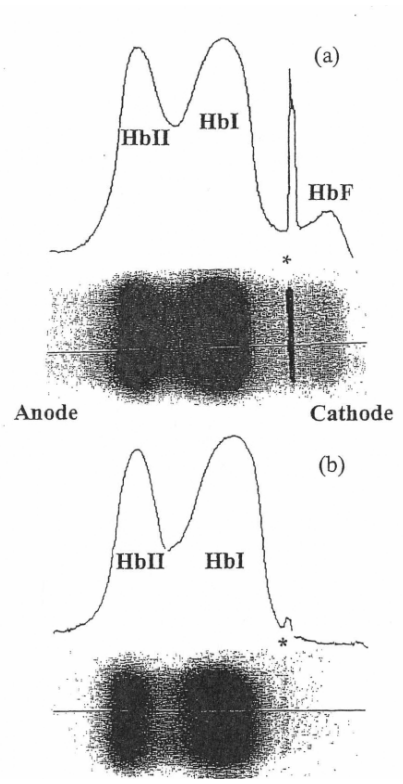

Fig. 1. (a) Three peak hemoglobin pattern of a 16 day old chick. The fetal hemoglobin is cathodic. HbI and HbII are anodic. (b) Two peak pattern of a 37 day old chick. Only HbI and HbII are present.

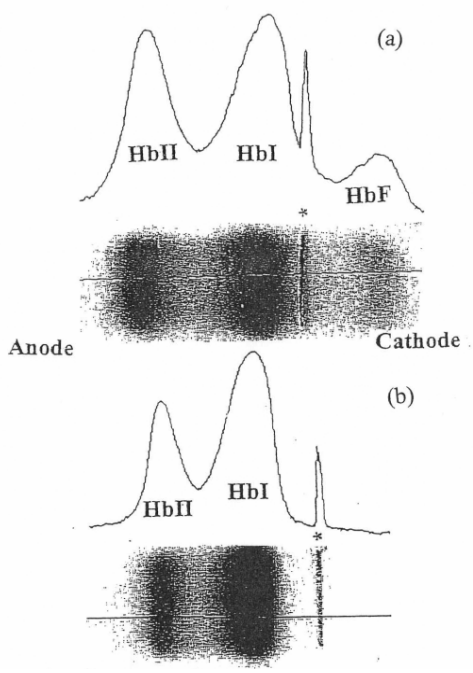

Fig. 2. (a) Three peak hemoglobin pattern of a 22 day old duck. The fetal hemoglobin is cathodic. HbI and HbII areanodic. (b) Two peak pattern of a 50 day old duck. Only HbI and HbII are present.

for fowl, of hatching, and preferably the time of hatch, since a gap of 24 or more hours can occur between early and late hatching of a single lot of birds. The more typical approaches used by researchers to determine rbc life span has included intravenously injected $Na_2Cr^{51}O_4$,[3] C^{14},[5] radioactive selenium[6], radioactive chromium[7,8], radioiron[9], and radioactive lysine[10,11].

The assumption, when utilizing HbF to determine rbc life span, is that the production of HbF ceases upon hatching, and that HbF and the HbI's and HbII's occur as mutually exclusive in separate rbc's. The extent to which different hemoglobins are present in the same red cell is undetermined[1]. It was found by immunofluorescent labeling that up to 25 percent of the rbc's in metamorphosing *Xenopus laevis* contain both adult and tadpole hemoglobins[12]. However, in a study of *Rana catesbeiana*, indications were that tadpole and frog hemoglobins do not coexist within a single erythrocyte in detectable amounts[13]. In humans, hemoglobin F is the major hemoglobin of fetal life and small amounts of this hemoglobin normally persist in adult life[14]. This may be explained by the presence of both adult hemoglobin and hemoglobin F coexisting within a single rbc[15]. In the present study no trace of fetal hemoglobin appears after 31 days in chickens and after 47 days in ducks.

Daily sampling of blood just prior to the estimated time of the disappearance of HbF provides a more accurate approximation of the rbc life span in the fowl. Only a small sample is needed to perform the analysis (2-4 µl).

Additional studies are being performed with pigeons, guinea fowl, and turkeys.

Acknowledgments

Thanks are extended to W. Elliott, Instructional Technology Services, Monmouth University, and to the Monmouth University Biology Department for their project support.

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Age of Red Blood Cells in the Muscovy Duck (*Cairina moschata*)

by

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Estimates of the age of red blood cells (rbcs) have been made for many vertebrate species[1]. Various techniques are used to make these estimates. These techniques are discussed elsewhere[2]. This author examined age of red blood cells in several bird species with a technique that utilizes the disappearance of fetal hemoglobin as determined by agarose gel electrophoresis[3]. The determination assumes that fetal hemoglobin production ceases upon hatching, but persists in the rbcs until the death of the cells containing the fetal hemoglobin.

Muscovy ducklings were obtained from a commercial hatchery. These were maintained for the duration of the study on wire cages in the laboratory. They were fed and watered daily. Blood was drawn from their left ulnar artery in microcapillary tubes on their arrival (three days) and at approximately seven day intervals after, until the disappearance of their fetal hemoglobin. Electrophoretic patterns were integrated and percents for each peak in the patterns determined.

Three hemoglobin peaks were discerned until the 82nd day of sampling. At this time the fetal hemoglobin (HbF) was no longer evident. This peak is cathodic, as opposed to the two adult hemoglobins (HbI and HbII), which are anodic. HbF remained at almost 20 percent 14 days after hatching, then declined to zero by the 82nd day. Hemoglobin HbI increases from 50 to 68 percent of the total hemoglobins.

A comparison of the die-away of Muscovy duck fetal hemoglobin with that of Pekin duck (*Anas platyrhynchus*) fetal hemoglobin, using the same determination techniques, indicates that the life span of Muscovy duck rbc's is almost twice that of Pekin ducks (47 days)[4].

These species differ in several other ways, including the larger size of Muscovy ducks, and in their time of hatching, with Muscovy ducks needing 35 days and Pekins 28 days[5]. These species have been separated genetically for more than 50 million years[5].

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A Collaborative Survey Study of How Biology Faculty Perceive the Use of PowerPoint. Are We Really Making the Point?

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Abstract

A ten-statement faculty survey was developed by the authors concerning the use/non-use of PowerPoint (PPT) in biology courses. Two community college biology faculties were surveyed and their comments were recorded concerning PPT as a tool for classroom use. Results showed that the faculties are divided as to the effectiveness of the use of PPT in enhancing students' grades. However, students indicated to their instructors that they liked the use of PPT by faculty and found it helpful in their course work. Faculty comments from those that used PPT and those that did not use this technology are included in this study.

Introduction

In today's ever-increasing use of technology, PowerPoint (PPT) can be a useful tool to present biological concepts. However, there are a myriad of questions in the minds of biology instructors concerning the use of PPT by biology faculty. In order to try to answer these questions we designed a 10-statement survey to administer to our faculties. Survey research can be an important educational tool that involves a measurement procedure asking questions of respondents. Our faculty survey elicited information concerning opinions about PPT usage by biology faculties at two different community colleges; Kingsborough Community College/CUNY (KCC) and Nassau Community College (NCC).

Literature Review

A recent dialogue in the *National Education Association Newsletter*[1] focused on the use of PPT by community college instructors. The question asked was: "Does the use of PowerPoint presentations in class interfere with faculty-student interactions?" The two instructors who expressed their opinions had somewhat opposing views. One instructor, Dorothy Altman of Bergen Community College, in Paramus, NJ, uses PPT interactive modules in class (also available online) to teach students how to write research papers and believes that this method is highly successful. She feels that only thoughtfully created PPT presentations are helpful to students' learning. However, she points out that poorly prepared PPT presentations may restrict student-faculty interactions. Phil Rae Jack, a part-time community college instructor, took an opposing view. Jack states that PPT restricts faculty-student interactions. He likes "eye-to-eye" contact with the students and perceives that when the classroom is darkened students start communicating with each other using text messaging and other devices or they may become inattentive and fall asleep.

PPT may be used by instructors to teach their courses or by the students to present their own studies to the class. An interesting article by Carello[2] from the University of Wisconsin-Eau Claire, has an intriguing title, "Hi-Tech Presentations: Are they *Power*ful *or Point*less?" She asks whether the use of PPT improves students' learning as well as the quality of their presentations. Several studies have indicated that students may do better in class with the use of PPT. Carello had students in two classes of Comparative Vertebrate Anatomy presenting scientific papers. One group used overhead transparencies and the other group used PPT presentations. After students' presentations an examination was given to both groups. The group that was taught using overheads did better on the examinations. Carello repeated the study as a

controlled experiment; she then discovered that, based on examination performance, the students learned equally well using either overhead transparencies or PPT. However, she felt that the use of PPT by students themselves made for more creative, in-depth presentations. They also learned to use PPT as a tool for future projects.

Jackson[3], from the Indiana University of Pennsylvania (IUP) discussed the use of PPT to teach Comparative Politics. Jackson points out that faculty must be willing to learn the new technology and apply it in the classroom. He believes that, in his field, PPT usage is ideal for presenting line and bar charts of economic and political information. Of course, that can be said of biological research data as well. PPT video clips were also displayed in class and PPT quizzes were given to the students. Students' reactions to the use of PPT at IUP were very positive. Sixty-eight percent of the students strongly agreed that PPT presentations, coupled with handouts, supported the course content. They particularly liked the packet of PPT slide handouts. The same percentage of students felt that the PPT presentations made lectures more organized. A large percentage of students (strongly agree, 7%; agree 32%-40%) felt that PPT made lectures interesting and helped them take notes. When asked whether PPT helped them understand the material, 36% strongly agreed, and 51% agreed that this technology was helpful.

Susskind[4] reported more positive attitudes towards class work when taught with computer-mediated presentations as compared with overhead transparencies. Clark[5] discovered that PPT was effective only if it provided students with variety and also stimulated students' interest in the material being taught.

Su[6] found that chemistry students achieved well in classes when they were exposed to computer-based multimedia for animations, images and sounds. O'Day[7] concurred that animations-based PPT packages enhanced students' understanding of concepts in cell biology. Since anatomy is mostly a visual science, Carmichael, *et al*.[8] used PPT software for lectures in gross and developmental anatomy with success. Students found the instructor-prepared PPT slides helpful in labeling diagrams. Szabo and Hastings[9] compared grades of courses where PPT is used with grades in those courses where PPT is not used and found no significant differences in students' grades.

McDonald[10] uses the term *PowerPointlessness* to indicate that instructors may use PPT as a crutch, rather than a tool when they read from their slides. In order to prevent improper use of PPT, Eves & Davis[11] made the following suggestions:

- Match the method to the message.
- Create slides that enhance the message.
- Keep it simple.
- Stay in touch.
- Concentrate on content.
- Use appropriate images.
- Effects can distract.
- Minimize file sizes.
- Be prepared (technology problems).

Voss[12] asked the question, "PowerPoint in the classroom, is it really necessary?" She explains that often, students feel ignored during PPT lectures when instructors are not focusing on them. She also expresses students' frustrations with words flying across the slides, texts that are too small to read, and inappropriate images.

As can be expected, there are different opinions in academia on the use of PPT. Spurred by this diversity of opinions, we decided to survey biology faculty at both KCC and NCC in order to gain an insight into community college use of this technology.

Experimental Design

In the biology departments at KCC and at NCC, as well as at many other colleges throughout the country, there exists a trend toward the use of many kinds of technologies to teach lectures and sometimes laboratory material.

The degree of similarities among faculty members of schools is an important factor in designing and analyzing educational research. We decided to survey our biology instructors at both institutions in order to determine how many faculty members in our departments are using PPT presentations and to ascertain their views on the use or non-use of PPT in the classroom. We also wanted to determine the differences or similarities between the two groups' perceptions of the use of PPT in biology courses.

The instructors, in both institutions, come from diverse backgrounds, both in age and ethnicity. They teach general biology, anatomy and physiology as well as many elective biology courses.

Permission was granted by the institutional review boards on human experimentation at our respective schools for the faculty to be administered the PPT surveys developed by us (Table 1).

Results and Discussion

A total of 37 faculty members from both KCC and NCC, responded to our PPT survey. At KCC, 21 faculty members were surveyed; 14 faculty members stated that they use PPT, while 7 responded that they do not use this technology. At NCC 16 faculties were surveyed; 11 members said that they use PPT in the classroom, while 5 stated that they do not. In both institutions reasons for non-use ranged from lack of equipment, observed students' behavior during PPT presentations to teaching courses that do not lend themselves to the use of this technology.

Our survey consisted of 10 statements (Table I). Instructors were to rate these statements using the Likert scale shown below:

5=strongly agree 4=somewhat agree 3=undecided 2= somewhat disagree 1=strongly disagree.

Comments by faculty were also welcome. The first statement on the survey concerned the use of PPT by faculty. It asked instructors to judge whether they believed that students perform better when faculty use PPT. Fig. 1 indicated that 50% of KCC faculty was undecided on this point, while there was a split in the opinion given by NCC faculty, with 41% agreeing and 30% being undecided.

Statement II, seen in Fig. 2, concerned the feedback that faculty gets from students. All KCC faculty members agreed that students find PPT helpful to them in their coursework, and 60% of NCC faculty agreed as well. Fig. 3 (Statement III) illustrated faculty's position concerning whether students are discouraged from taking notes during PPT presentations. Approximately 70% of both KCC and NCC faculty disagreed with the statement. In order to corroborate statement III, faculty was asked whether students do take notes during PPT presentations. Fig. 4 (Statement IV) indicated that the majority of both KCC and NCC faculty believed that students do take notes.

Statement V asked faculty to indicate whether all types of coursework lend themselves to the use of PPT presentations. As seen in Fig. 5, there is a dichotomy of opinions on this statement among KCC faculty, while about 60% of NCC faculty disagreed with the statement. NCC faculty that teaches field courses stated that they do not believe the use of PPT is appropriate for their courses' content.

Do instructors believe that they could do a better job of teaching when using PPT? Fig. 6 (Statement VI) indicated that the majority of KCC faculty agreed with the statement, while NCC faculty indicated a 50% agreement. Statement VII asked faculty whether they also give handouts of the PPT slides. About 50% of KCC faculty disagreed and strongly disagreed with the statement, while 50% agreed and strongly agreed. Fig. 7 showed that 50% of NCC strongly agreed with the statement, with a few in disagreement. Statement VIII, seen in Fig. 8, asked whether instructors believe that students are more attentive in class when PPT presentations are used. Over 42% of KCC and 50% of NCC faculty were either undecided or disagreed with the statement that students are more attentive when PPT presentations are used. Fig. 9 (Statement IX) showed responses of faculty concerning whether they use publisher-prepared PPT presentations that cover the material to their satisfaction. The majority of faculty at both schools strongly disagreed with the statement. Statement X asked whether faculty prepare their own PPT slides (in part or whole). The overwhelming majority of instructors indicated that either they modify the publisher-prepared slides or make their own.

It is interesting that a good percentage of instructors at both KCC and NCC are unsure about the value of PPT to students' performance. This contrasted strongly with students' feedback. Students indicated to faculty that they find PPT helpful to them in their coursework. These opposing views need to be further examined.

Students do take notes from PPT presentation, although many of them attempt to just copy the slides verbatim without a true understanding of what they see. In some courses the PPT slides are provided on *blackboard* or copies of the slides are handed out to students.

A large majority of those faculties that use PPT stated that they do a better job of teaching with its use. However, some faculty noted that students are less attentive during PPT presentations, especially when copies of the slides are given. One suggestion was to hand out the copies at the end of the period, so that students are compelled to focus on the slides. It is important that any teaching method includes active students' participation.

Most faculties do not use publisher-prepared PPT slides, but those who use them often modify them. Recent versions of publisher-prepared slides are more user-friendly and they are easier to modify. Some faculties prepare their own presentations.

Fig. 1: The use of PPT by faculty helps students to receive a better grade in the class.

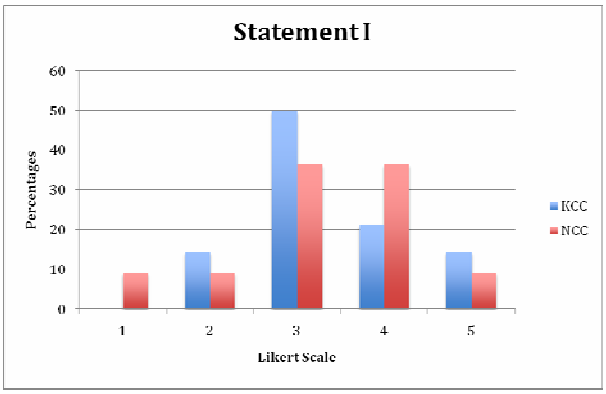

Fig. 2: Students say that they find PPT presentations to be helpful in their coursework.

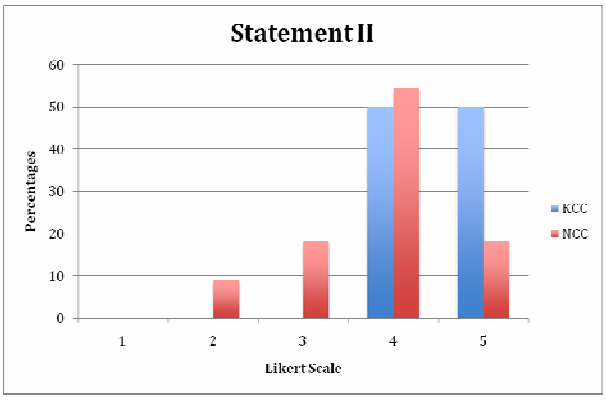

Fig. 3: PPT Presentations Discourage Students from Taking Notes.

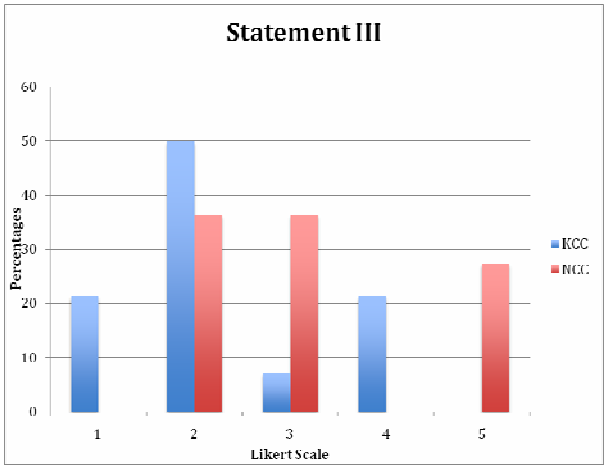

Fig. 4: Students do take notes from PPT presentations.

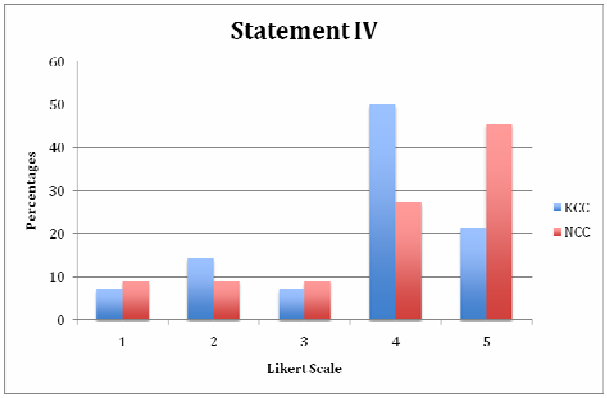

Fig. 5: All types of courses lend themselves to the use of faculty PPT presentations.

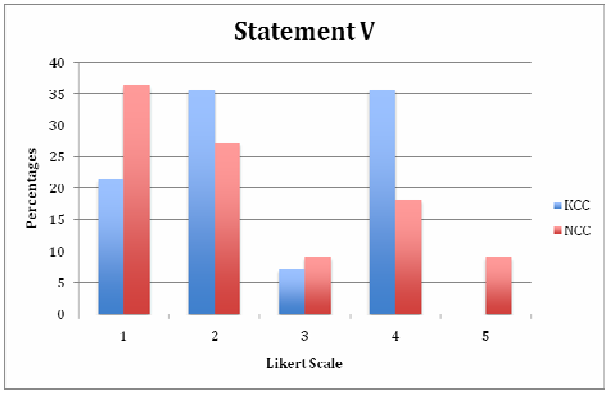

Fig. 6: I, as an Instructor can do a better job of teaching when using PPT to present the material.

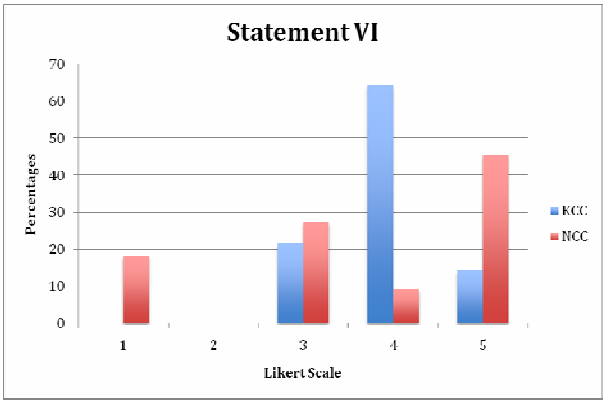

Fig. 7: As a user of PPT Presentations, I also give students handouts with the slides from the PPT presentations.

Fig. 9 I use publisher-prepared PPT presentations and I think that they cover the subject matter to my satisfaction.

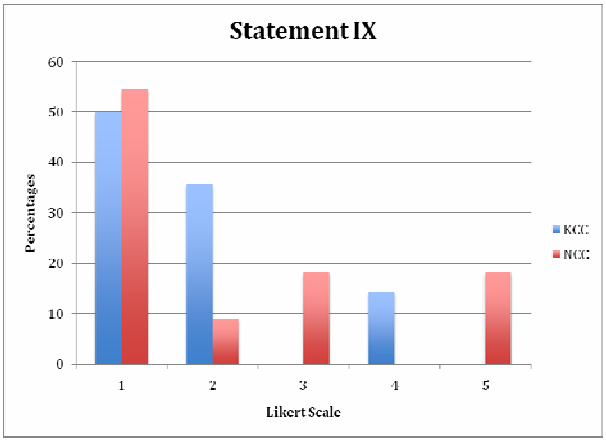

Fig. 8: Students are more attentive when I use PPT presentations.

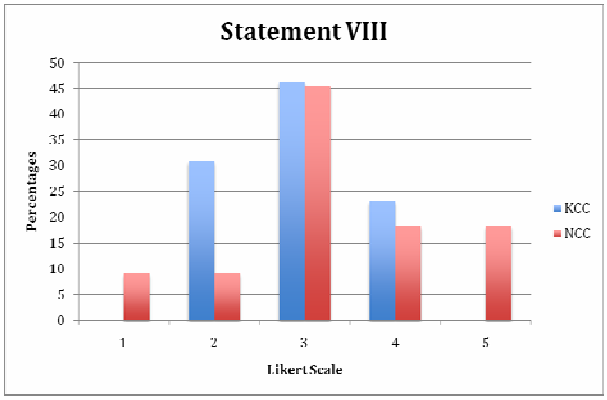

Fig. 10: I prepare my own PPT presentations (in part or whole) because I believe that are more effective in teaching the material than the publisher-prepared presentations.

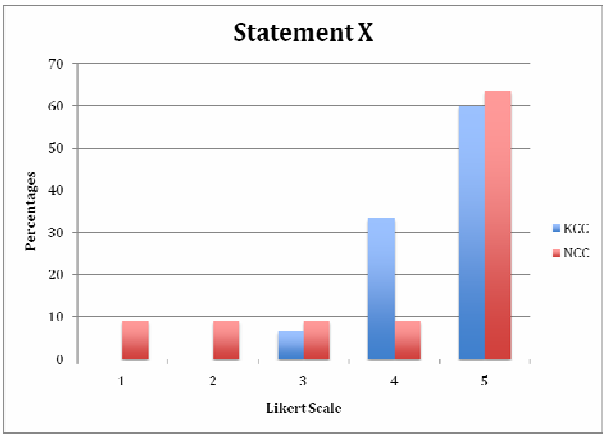

Table I: Instructor Survey of the Use of PPT Presentations During Classroom Instruction

Courses you teach_____
A. Do you use PPT presentations in your classroom instruction? (Y or N)_____
B. If no, give reason(s) why you choose not to use these presentations_____
If you answered "Yes" to the first question, then answer the statements below using the following Likert Scale:
5=strongly agree 4=somewhat agree 3=undecided 2= somewhat disagree 1=strongly disagree

Place number of your response on the line following each statement.

1.The use of PPT by faculty helps students to receive a better grade in the class.___
2. Students say that they find PPT presentations to be helpful in their coursework. ___
3. PPT presentations discourage students from taking notes. ___
4. Students do take notes from PPT presentations. ___
5. All types of coursework lend themselves to the use of faculty PPT presentations. __
6. I, as an instructor, can do a better job of teaching when using PPT to present the material. ___
7. As a user of PPT presentations, I also give students handouts with the slides from the PPT presentations. ___
8. Students are more attentive in class when I use PPT presentations. ___
9. I use publisher-prepared PPT presentations and I think that they cover the subject matter to my satisfaction. ___
10. I prepare my own PPT presentations (in part or whole) because I believe that they are more effective in teaching the material than the publisher-prepared presentations. ___

Write any comment that you wish about the use of PPT presentations by instructors.

Faculty Comments:

Our survey also asked for instructors' comments For the purpose of clarity, we organized some of the comments into categories and these comments are shown below. They are from faculties who use or do not use PPT.

Category 1. Use of Publisher-Prepared PPT Slides.

KCC:

"It makes my job easier. I'm not convinced it helps most of the students, but it COULD if they would make full use of it…"

"I think you can't just use the publisher's slides because they are sometimes inaccurate or just contain 1 or 2 sentences of written material. I always modify them some".

NCC:

"I use only the pictures/illustrations from the publisher's slides."

"PPT slides from the publishers are too wordy, so I modify those slides. I teach from my own notes."

Category 2: Use of PPT Presentations as an enhancement to the Lecture.

KCC:

"Use of PPT gives the instructor more time to 'explain' the concepts rather than dictating the notes".

"Prefer active teaching rather than students reading slides in a dim room!!".

NCC:

"PPT keeps the lecture and Lab m a t e r i a l organized."

"PPT slides combined with handouts assist students in better understanding of new concepts."

Category 3: Comparison of PPT Effectiveness versus Traditional "Chalk and Talk".

KCC:

"If instructors intend to use PPT, the presentations need to be designed to promote student interaction and be reflective of the objectives of the course content".

"Using PPT should enhance but not replace the lecture!"

NCC:

"PPT slides provide organization but less time for personal interaction."

"PPT helps instructors to keep lectures with proper outlines and pictures. I find that I tend to lecture faster with PPT".

Category 4: How the Use of PPT Affects Students

KCC:

"For Bio 11 students (first semester A& P) PPT helps greatly with their understanding in the class. PPT helps them with self-study after class. I use PPT instead of any other handout".

"The type of students enrolled in Bio 12 (second semester A & P) can profit from a more standard type of traditional instruction and is easily overwhelmed with the fast-paced PPT presentations".

NCC:

"Students are given access to PPT slides through *WebCT/Blackboard* which allows them opportunity to come prepared to the class or review."

"Some students print out all slides for each chapter and never spend time to understand, as they feel they can do it later."

Category 5: PPT Usage and Note-taking by Students

KCC:

"I hate watching the students scramble to write every word down: so the written parts aren't what I think is most useful. …. Most of my students know (or find out) that not everything they need to pass the exams is in the PPT presentation".

"Prefer to have students write out notes and draw diagrams that may be crude compared with the book, but which they can use on exams to demonstrate that they have a working knowledge…."

NCC:

"Some students want to write down each and every word. They miss out on examples or discussion about the concepts."

"Other students think they have access to these slides on WebCT and do not take any notes. Some of them do not get to open slides until the night before their exam."

Category 6: Benefits of PPT Presentations to Second Language speakers.

KCC:

"PPT is good for foreign-born instructors as well as students because it helps them with language problems that might effect the ability of the audience to comprehend the material".

NCC:

"PPT is good for visual learners, provides a venue for interactive sessions when diagrams are used without labels, helps students to recognize the pronunciation of vocabulary and their spelling. Labeled diagrams allow students to connect all the components of a concept."

Conclusions

In conclusion, faculties from KCC that use PPT generally find this technology helpful, whereas at NCC, many instructors did not agree. For example, some faculty state that they do not use PPT because of lack of resources or because of the likelihood of technology failures that can lead to valuable time loss in the classroom. Young[13] presented highlights of a students' survey about teaching and technology conducted at 13 colleges. Some students in the survey commented that sometimes professors spend too much time troubleshooting rather than teaching. Faculty at both institutions, KCC and NCC agreed that technology must be used appropriately to help students develop critical thinking and problem solving skills. In other words, PPT lectures should not be a mere reading of slides by faculty, but rather a source of interaction between students and instructors. For that reason, we were not surprised to discover that most faculties modify the publisher-prepared PPT slides.

Eves and Davis[11] agreed that using publisher-prepared PPT slides incorrectly severely limits the ability to engage students in classroom discussions. Faculty in our study made similar comments. Whether or not instructors choose to use PPT lectures, it's quite apparent that this technology is here to stay. For this reason, institutions must provide professional development opportunities so that this technology can be used most effectively. At KCC, a Center for Teaching & Learning, as well as the Office of Instructional Computing, have been providing instructors with workshops and seminars in order to ease faculty into the use of technology in the classroom. At the same time, NCC faculty is provided with opportunities to learn basic tools of technology through the Office of Institutional Technology. Also, the Faculty Development Committee of the Academic Senate at NCC invites many speakers from inside and outside the campus to share their expertise.

Certainly, the use of technology in the classroom is widespread and administrators as well as the majority of faculty support its use. Today, most students are visual learners and, therefore, visual techniques of all kinds should be helpful to them. The jury is still out as to whether or not the use of PPT presentations truly improves students' learning. Perhaps long-term studies will provide an answer to this question.

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