STEM EDUCATION PAPER ABSTRACTS

USING INTERNET OF THINGS FOR AN ALTERNATIVE PEDAGOGY FOR INSTRUCTORS. *ANTHONY WINCHESTER*, KARTHIKEYAN LINGASUBRAMANIAN, THE UNIVERSITY OF ALABAMA AT BIRMINGHAM.

The classroom of the Industrial Revolution is phasing itself out. Today's students are being raised in the Digital Age, and the lecture based classroom does not work in entirety for them as in previous generations. The discussion bores them after only a few minutes, and they are on to the next thing, even if it is being entertained through social media. Their learning style goes beyond the outdated lecture. To grasp the attention of the student in the Digital Age, instructors must consider strategies that are outside the methodology that they have been taught to use. This work explores the use of Internet of Things (IoT) technology in education to effectively prepare the student for the future. IoT, which is an engineering technology, primarily depends on computational and communication mediums. Our work focuses on the development of a computational medium which is free-standing, portable and cost-effective with communication abilities. The platform is designed to be cost-effective, and simple to operate so that teachers without technical or engineering training can employ it. This tool also allows students to learn themselves about a given environment through sensors and analyze it. Such an easily portable system will enable students to have off-the-class education, which will be more hands-on and practical.

UNDERSTANDING AND USING PIAGET-POPPER CONSTRUCTIVISM METHOD WITH SYMBOLIC MENTAL STRUCTURES AND PATTERNS TO IMPLEMENT CRITICAL THINKING. *MATTHEW EDWARDS*, ALABAMA A&M UNIVERSITY.

The human intellect persists in a dynamical equilibrium state while maintaining self-satisfaction and a contented worldview by constantly integrating and assimilating incoming information that resonates with its current understanding and previous experiences. Learning a new concept requires the mind to enter into a state of disequilibrium and then progress through identified stages to re-establish eventually a new state of equilibrium. This equilibrium state allows reflective thought and reassurance to the individual about what is already known albeit it with a limited generalization. However, with the onset of receiving and assimilating a new concept, you are thrown into a state of mental disequilibrium. It is the need to remove the disequilibrium that requires either critical thinking by the individual, resulting in an expanded worldview, or a discounting of it while maintaining a disengaging behavior. The former allows re-establishment of mental equilibrium with an expanded understanding, and the latter persists by never departing from equilibrium. In either case, the intellect has its equilibrium—one instance with the requisite development of new understanding, the other without change. To address the lack of effective learning, we have developed the notion that individual Symbolic Mental Structures, as a key component of constructivism, can assist the underachieving student to become more engaged in the physical sciences and academia in general. This approach

requires us to revisit Piaget's constructivism theory, Karl Popper theory with its falsifiability criterion.

"THIS COULD BE A GAME!" : ENERGIZE AND ENGAGE YOUR CLASSROOM INSTRUCTION WITH A GAMIFIED STUDENT RESPONSE SYSTEM. *SAMIKSHA RAUT,* UNIVERSITY OF ALABAMA AT BIRMINGHAM.

Student Response Systems (SRSs) or "clickers" are small hand-held devices that are popularly used in today's classroom as an engagement and assessment tool. An advantage of using SRSs is that it can give instant feedback to both the students and instructors about a concept under study. Besides, it guarantees anonymity, efficiently gathers student responses and prevents peer-to-peer interactions that may otherwise interfere with a typical classroom assessment. However, usage of these devices involve higher costs for the students and often pose technological challenges for an instructor. Therefore, very recently an extension of SRSs known as "gamification" or the use of game-like elements in non-game contexts has become popular in education. Hence, this presentation is geared towards discussing the distinct benefits and advantages of utilizing a freely downloadable gamification software "Kahoot!" as an effective tool to energize and engage your classroom instruction.

IMPROVING UNDERSTANDING OF NATURAL SELECTION USING EVOLVING DIGITAL ORGANISMS. *MICKIE POWELL* AND SAMIKSHA RAUT, UNIVERSITY OF ALABAMA AT BIRMINGHAM.

Undergraduate biology students often struggle with the concepts of natural selection and how it can result in evolution of species. Since the time scale of evolution is difficult to reproduce in the lab, computer software has been developed that makes it possible for students to design and perform experiments to test hypothesis about the mechanisms of evolution using digital populations. Avida-ED is an open access digital software program developed, at Michigan State University, as a tool to help teach about evolution and the scientific method. We have applied this program to help students gain a better understanding of how random mutations and natural selection result in populations becoming adapted to their environment. Students use the Avida Ed program to investigate how random mutations and the presence of antibiotics in the environment can give rise to antibiotic resistant populations of bacteria. Students can then continue their investigations and formulate independent hypothesis and design experiments in Avida-ED to test them. The program generates real unique data for each experiment, which can be graphed and analyzed statistically. The versatility of the platform allows it be introduced in courses from the freshman to the senior level.

EFFECTS OF INSTRUCTIONAL STYLE ON STUDENT PERFORMANCE: A COMPARATIVE ANALYSIS OF A NON-MAJORS BIOLOGY COURSE. *UDUAK AFANGIDEH*, FAULKNER UNIVERSITY. BISOO MARANDA, ALABAMA STATE DEPARTMENT OF EDUCATION.

In most universities, students are required to take a natural and/or physical science course as part of the core curriculum. While this is often a freshman level class, students at all levels find these courses challenging resulting in high withdrawal and failure rates. While there is an abundance of research suggesting factors that are responsible for student's poor performance in science courses both at the high school and undergraduate levels, here is a continued need for science professors to present scientific information in a way that will engage the non-science major. This paper investigates the role that the method of instruction has on student performance. The study was conducted over a four – year time frame involving about 400 students who are non-biology majors enrolled in an introductory biology class at Faulkner University. Two different methods of instruction were used in alternating semesters by the same instructor to reduce sources of bias and error. Correlation analysis was carried out and results indicated that there was a strong positive correlation ($r = 0.98$) between the methods of instruction and student performance, There was an increase in student engagement with course material which resulted in better test grades, and an improvement in all the variables investigated. Student responses during end of session evaluation surveys also supported these findings.

LESSONS FORM THE WAR ZONE: THE 2017 TOTAL SOLAR ECLIPSE MANIA. *MEL BLAKE*, UNIVERSITY OF NORTH ALABAMA.

The Great American eclipse of august 2017 offered an unprecedented opportunity to engage the public with science ans astronomy. The entire country was obsessed with the event, which was probably the most watch event of the entire year. The frenzy created a rush for eclipse glasses and for astronomers to give presentations. there were floods of emails and phone calls that came in faster than they could be answered. It created an almost under siege feeling to the whole thing. I will discuss some of the lessons I learned about how to handle a large event, and some of the deficiencies in my planning for the outreach that others might benefit from if they become part of a large event.

A RADIO ASTRONOMY CUBESAT FOR STEM EDUCATION. *DR. J. WAYNE MCCAIN*, ATHENS STATE UNIVERSITY. COLLIN ROGERS MCCAIN, CALHOUN COMMUNITY COLLEGE.

This paper summarizes research and a proposal to develop a Radio Astronomy (RA) CubeSat, small satellite, in conjunction with the Society of Amateur Radio Astronomers (SARA) with direct application to STEM education in the North Alabama area. The project will involve collaboration between SARA, the SPARK Academy at Cowart Elementary School (Athens), Athens State University, Vanderbilt University (Nashville, TN), and Florida Institute of Technology (Melbourne, FL). This 2-4 year project would place a 4x4x4 inch, 3-pound autonomous satellite in low Earth orbit to monitor low and very low-frequency radio signals

from our solar system which are normally 'blocked' by Earth's ionosphere. Typical signals are from our Sun and the Jupiter/Io magnetic storms but also include deep-space emissions from other celestial bodies and phenomena.

THE TITANIC DISASTER - POOR RISK MANAGEMENT. *LOGAN SULFRIDGE*, ATHENS STATE UYNIVERSITY. J WAYNE MCCAIN, ATHENS STATE UNIVERSITY.

This student research paper examines the historical Titanic's sinking of 1912 and the issues that led to the demise of this 'unsinkable' ship, the leading technical achievement of its time. In addition, the ship's operational management is contrasted against modern-day risk management planning methodology showing short-comings and the human errors involved that precipitated the event. Even today, there are lessons to be learned from this horrific and arguably unnecessary loss of over 1500 lives.

IMPROVING SUPPLEMENTAL INSTRUCTION THROUGH ACTIVE-LEARNING MODULES IN INTRODUCTORY BIOLOGY. *SEBASTIAN SCHORMANN*, JAMES BOYETT AND SAMIKSHA RAUT, UNIVERSITY OF ALABAMA AT BIRMINGHAM.

Over the last decade there has been a heightened focus to increase the retention of Science, Technology, Engineering, and Mathematics (STEM) majors, with an intent to enhance the diversity of STEM professionals. Many of these retention efforts are focused on large enrollment introductory courses that undergraduates take as freshman or sophomores and are characterized by the highest attrition rates. In response to this problem, numerous studies have shown that incorporating active-learning practices in the classroom can lower the failure rates and also greatly benefit first generation underrepresented minority students. Despite these advantages, active-learning does become challenging to implement in the classroom as the student to the instructor ratio increases. In order to overcome this issue, it has been suggested to introduce active-learning outside the classrooms in peer led sessions also known as "Supplemental Instruction" (SI). Therefore, the goal of this study is to investigate the impact of active-learning modules in the SI sessions. We are currently implementing this model for our spring 2018 Introductory Biology I & II courses. Initial observations have suggested greater student engagement, motivation, and understanding of the concepts. Additional, qualitative results will be gathered through student surveys rating the effectiveness of these sessions at two time points during an entire term. We believe that data from this study will enable us to recommend the introduction of active-learning modules as an effective avenue in the SI to reduce STEM attrition in introductory level classes.

STEM EDUCATION POSTER ABSTRACTS

IMPROVING SUPPLEMENTAL INSTRUCTION THROUGH PEER-LED GROUP DISCUSSION IN INTRODUCTORY BIOLOGY. *SEBASTIAN SCHORMANN* AND JAMES BOYETT, UNIVERSITY OF ALABAMA AT BIRMINGHAM.

Science, Technology, Engineering, and Math (STEM) majors have experienced a high attrition rate within the United States despite extensive efforts by the education system to address this concern. Large enrollment introductory courses taken by undergraduates as underclassmen have been identified as a principal cause of the leakage in the STEM academic pipeline. Intervention in the form of Supplemental Instruction (SI) has been implemented to increase STEM retention, but traditional lecture models commonly employed in SI have failed to develop conceptual comprehension and other critical thinking skills required for students in future STEM careers. The scope of this investigation was to address this shortcoming in SI by employing more-effective active learning models within the sessions. This goal of our investigation was approached by presenting students with open-ended questions and asking students to form groups to discuss the questions. Implementation of the proposed changes are being conducted during this current spring 2019 semester in Introductory Biology I and II classes at UAB. Observational results have shown greater student engagement, motivation, and understanding of the material; further qualitative results will be gathered through student surveys rating the effectiveness of SI sessions at the midpoint and conclusion of the term. Exams are regularly conducted as part of the course, and student performance on these exams will be analyzed for the efficacy of this intervention. The outcomes assessed from this project can be utilized to make foundational improvements in SI and establish it as an effective avenue to reduce STEM attrition in introductory level classes.

SUSTAINED TEACHING MENTORING WORKS AND BENEFITS MENTORS AS WELL AS THOSE MENTORED. AN UPDATE ON THE PROMOTING ACTIVE LEARNING AND MENTORING (PALM) NETWORK. *SAMIKSHA RAUT*, UNIVERSITY OF ALABAMA AT BIRMINGHAM. SARA BROWNELL, ARIZONA STATE UNIVERSITY. SUE WICK, UNIVERSITY OF MINNESOTA-TWIN CITIES. AMY PRUNUSKE, MEDICAL COLLEGE OF WISCONSIN. MICHAEL WOLYNIAK, HAMPDEN SYDNEY COLLEGE. MARK PEIFER, UNIVERSITY OF NORTH CAROLINA CHAPEL HILL.

Many instructors and instructors-to-be have heard of the value of using active learning to guide students to deep learning of course material. Some have attended workshops or several-day immersion experiences to learn how to employ effective active learning activities. In spite of best intentions, plans to actually implement active learning techniques often collapse once an instructor gets caught up in the academic year. To address this situation, ASCB, in cooperation with other professional societies and academic groups and with NSF funding, established the

Promoting Active Learning and Mentoring (PALM) Network. This program provides PALM Fellows with a one-on-one teaching mentoring relationship for at least one semester with a mentor experienced in active learning. Participants to date have come from various partner societies within the Network. Analysis of teaching behavior before and after mentoring provides evidence that Fellows have been able to increase their use of active learning in accord with the specific objectives they had identified. Interviews with participants indicate that Fellows gain more confidence in their ability to apply active learning principles in future coursework, and mentors appreciate the opportunity to reflect on, refine, and expand their own practice of active learning approaches.

A RADIO ASTRONOMY CUBESAT FOR STEM EDUCATION. *COLLIN ROGERS MCCAIN*, CALHOUN COMMUNITY COLLEGE. DR. J. WAYNE MCCAIN, ATHENS STATE UNIVERSITY.

This poster summarizes research and a proposal to develop a Radio Astronomy (RA) CubeSat, small satellite, in conjunction with the Society of Amateur Radio Astronomers (SARA) with direct application to STEM education in the North Alabama area. The project will involve collaboration between SARA, the SPARK Academy at Cowart Elementary School (Athens), Athens State University, Vanderbilt University (Nashville, TN), and Florida Institute of Technology (Melbourne, FL). This 2-4 year project would place a 4x4x4 inch, 3-pound autonomous satellite in low Earth orbit to monitor low and very low-frequency radio signals from our solar system which are normally 'blocked' by Earth's ionosphere. Typical signals are from our Sun and the Jupiter/Io magnetic storms but also include deep-space emissions from other celestial bodies and phenomena.