Maricopa Community Colleges Innovation of the Year Application

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College	Project title		
Glendale	**Using Adaptive Learning Software to Improve Academic Persistence in First-Generation Community College Students**		
Team members – List the team members involved in this project, including yourself. Provide name, job title, email for each. One person per line.			
Sara Watt Astronomy Faculty sara.watt@gccaz.edu			
A team photograph including all members must accompany this application. Photograph must be 5"x7" and 300dpi or larger. Create a caption for this photograph Identifying team members (using full names) in order of appearance from left to right.			
Sara Watt			
Executive summary (50 words or less)			
First-generation college students suffer from a lack of persistence, characterized by feeling they cannot succeed in a science course, and therefore shouldn't try. Adaptive learning platforms provide a powerful way to meet student needs. Implementing adaptive learning in the astronomy curricula has produced a significant increase in student persistence.			

Innovations should include information that addresses all of the criterion below and is in alignment with the Maricopa Vision, Mission, and Value Statements.

Quality: It is evident that the innovation increases "quality" in the course, program, office, or institution.

Project-Based Learning (PBL) has a large body of research supporting its effectiveness. Of particular interest is how it promotes sustained engagement with the material. Ames (1992) found that the orientation of PBL towards learning and mastery, rather than simply completing assigned classwork, causes students to be more apt to exhibit sustained engagement. Similarly, Bloomfield *et al.* (1991) noted that PBL provides variety and "non-school-like" problems, which increase students' perceived value of the material. Boaler (1997) found that PBL was associated with an increased willingness to approach mathematical challenges with a positive attitude; my experience has been that the math content in astronomy is often the primary cause of lack of persistence. Boaler was echoed by Bartscher, Gould, and Nutter (1995), who found that 82% of surveyed students agreed that PBL helped motivate them and increased their interest in the topic.

Clearly, PBL curricula have been shown to be a powerful intervention for low-persistence students. The challenge, however, is how to integrate this into the classroom while still covering all the required objectives. Adaptive learning platforms, such as Smart Sparrow, enable students to work individually or in groups outside of the classroom yet still synergize well with activities inside the classroom.

In examining student persistence in AST 106: Life in the Universe, I found three groups: 1) students who successfully completed all assignments; 2) students who completed assignments initially, but then only sporadically as the semester progressed; and 3) students who gave up early and either withdrew from the class or stopped attending without withdrawing. Students who persisted attained a high overall course grade, while those who gave up during the semester either barely passed with a C or received a D. There were few cases in which a student continued to work throughout the semester and did not achieve an A or B for the course.

Prior to using the Habitable Worlds courseware from Smart Sparrow, 36% achieved an A or B (with only 5.6% achieving an A). 43% achieved a C or D, while 23% earned either an F or withdrew. My focus was to find a way to help this middle group persist in their learning and move to the upper group.

After three semesters of using HabWorlds, the upper group rose to 52% (with 20% receiving an A). As hoped, virtually all of this improvement came from students moving up from the C/D group (now 26%). The percentage of students receiving an F or withdrawing was nearly unchanged at 22%.

Integrating the HabWorlds content has also improved the quality of the mathematical content in the course. Students now complete more complex calculations of planetary properties, which was too difficult before the implementation of HabWorlds.

Efficiency: There is evidence that the innovation contributes to a more efficient way of doing things.

Over the past decade the trend in astronomy teaching has been to move toward more qualitative reasoning using lecture tutorials rather than quantitative analysis of astronomy concepts. A standard 16-week lecture course cannot include enough time to teach the required concepts as well as provide enough support for students who struggle with the math. Math-based assignments are typically where I see the most pronounced lack of persistence. While the lecture tutorial method of teaching logical reasoning is useful, it is difficult to push students into higher levels of Bloom's taxonomy since this requires time to allow students to push through the math, assimilate the data, understand the meaning of their answers and generate alternative explanations for discrepancies. Persistence is the key to getting them through this process.

By implementing the HabWorlds courseware in a "flipped classroom" approach, I was able to provide much of the instruction in the lowest levels of Bloom's taxonomy outside the classroom at the student's pace making more efficient use of face-to-face class time. I can now use instructional class time to support students with math instruction, practice calculations, and lead students to develop their own hypotheses and to provide evidence to support their ideas using the methods taught in class -- exactly what a science course is designed to achieve but often has difficulty getting students to accomplish.

Cost effectiveness: There is evidence that the innovation adds a value to the institution while at the same time containing or reducing costs.

Like many Astronomy programs, the Glendale Astronomy Department has used Bennett's *The Cosmic Perspective* as the textbook. This is a fine introductory text which covers all of the concepts freshman- and sophomore-level students should understand about science and astronomy. Unfortunately, the textbook costs nearly $150 -- far out of reach of many of the low-income students we see in community college. The students need, however, a source of guidance at home when their professor is not around. Smart Sparrow allows me to eliminate the textbook requirement entirely, and at less than $40, is a dramatic savings for the students.

Many community college students today are choosing their college courses based not upon their interests or needs, but simply based on whether they can afford the course and required books. Smart Sparrow has made the Astronomy program an even more attractive choice for students.

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Replication: The innovation selected can be replicated in other institutions with a minimum of difficulty.
Habitable Worlds courseware is available to institutions across the country and internationally through the Inspark Network. The Inspark Network provides support for faculty adopting the courseware and networking opportunities to share ideas and classroom activities. The purchasing format allows instructors to require access as if it were a textbook which eases adoption of the courseware across many campuses. **As one of the first adopters of HabWorlds outside of ASU, I am often asked to speak with new adopters to share my best practices, my in-class activities, and to discuss ideas for the class. In the past 3 years, several astronomy departments within the Maricopa Colleges system have offered the Life in the Universe course using HabWorlds in a flipped classroom approach based on my work.**
Creativity: The innovation should be as original as possible or the adaptation should be creative.
The overall Life in the Universe course is designed around the Habitable Worlds courseware on the Smart Sparrow platform. The courseware includes a final project in which the students are presented with a field of 500 stars. Around one of those 500 stars is a habitable planet. Using scientific analysis techniques taught in the course, students classify stars and evaluate them for suitability, detect planets from observable data and evaluate those planets for habitability in the search to find that one habitable planet. This project-based learning platform is used as the final learning assessment, but the game-like aspect of the project engages students in a way that pushes them to persist through challenges to accomplish a goal. **Students are given basic instruction of appropriate astronomy topics through interactive lessons on the Smart Sparrow platform. Then I designed classroom activities to practice and apply their learning in new situations, use their results to evaluate for likely habitability, and give students the opportunity to formulate hypotheses for situations which disagree with their preconceptions. This structure gives students many opportunities to solve problems and succeed in small ways which builds the confidence to push through tougher challenges thus increasing persistence.**
Timeliness: The innovation should not be more than five years old in the institution, but it must have been around long enough to be tested so that it meets most of the criteria.
The *AST 106 Life in the Universe* course was designed and first offered during Fall 2013. At the time, appropriate courseware was not available, so most course homework was offered through instructor generated quizzes on Canvas. During the Spring 2014 semester, I identified lack of persistence as major issue in students not completing homework, and I was unsatisfied with the quality of the coursework on Canvas. I developed some classroom activities but saw no significant improvement. **In Spring 2015, Arizona State University and Smart Sparrow made Habitable Worlds available for adoption at other colleges. My course was one of the first full implementations of HabWorlds in an AST 106 course using an in-person format rather than an online format as HabWorlds was originally designed. Evaluation of the courseware and class format was accomplished using the CURE attitude survey to investigate lack of persistence causes. SRI International conducted an independent evaluation of GCC's Smart Sparrow.**

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In Fall 2015 I fine-tuned the adaptive feedback in Habitable Worlds using the evaluation results and offered full day open-house office hours to provide extra support for struggling students. After 3 semesters using the HabWorlds courseware, I identified a significant improvement of student persistence.

My success has inspired the Glendale Astronomy Department to switch the remaining astronomy courses to a flipped classroom format using the Smart Sparrow platform. I was awarded a sabbatical for the 2016-2017 academic year to design lessons and projects for AST 111: Solar Systems Astronomy and AST 112: Stars, Galaxies and Cosmology. The new courseware was implemented in stages over Spring and Summer 2017 with revisions and expansion to other faculty during Fall 2017. The results of student persistence in the new courses will be collected through the Fall 2018 semester and are part of a future project.

Learning: The results of the innovation have been shared with others for the benefit of students throughout Maricopa.

These results were presented at the Digital Learning Innovation Award presentations at the Online Learning Consortium Accelerate 2017 conference in November 2017. This project was one of ten faculty-led innovation projects which were awarded a $10,000 national prize and were highlighted by the OLC during the conference.

The results have also been shared with the Astronomy Instructional Council which connects astronomy departments across the Maricopa system. The success of the persistence improvements has led to the adoption of a flipped classroom approach to teaching by the entire Glendale Astronomy Department who have also become advocates for the method at other colleges.

Collaboration: The innovation successfully demonstrates collaboration, teamwork, and cooperation to ensure continuous process improvement efforts on behalf of students throughout Maricopa.

Implementation of the HabWorlds courseware has been a product of collaboration between the HabWorlds developers, Dr. Ariel Anbar and Dr. Lev Horodyskyj at Arizona State University, the Smart Sparrow team, and Glendale Astronomy. As an early adopter, I am invited to give feedback on improvements to the HabWorlds simulations and course development on a regular basis. The CURE survey results were gathered by Chris Mead at Arizona State University.

Based on the success of the HabWorlds implementation in my course and my sabbatical work, the Glendale Astronomy Department as a whole has adopted the flipped classroom approach to student learning in all our offered astronomy courses. Through the process of implementation, I have gathered feedback on how my colleagues, Keith Watt and Brian Gleim, use the courseware. I have made changes to my own implementation based on their suggestions, and we have worked together to improve the in-class activities. Eventually we plan to produce our own lecture tutorial book which can be provided to the students at cost further reducing the price of materials in the AST 111 and 112 courses.

The Astronomy Instructional Council is in the process of creating a repository of labs developed at each of the Maricopa Colleges. In addition to laboratory exercises, I plan to make the in-class materials freely available for use in Maricopa to improve learning outcomes across the colleges.

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