ASSESSMENT OF THE UGA "*INTRODUCTION TO WATERSHEDS*" MODULE

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Abstract. The Watershed UGA program is an interdisciplinary effort to improve overall water resources education and understanding of society's connection to nearby waters. Part of this program is to design and implement curriculum for both science and non-science majors. The *Introduction to Watersheds* module was designed to introduce various topics and provide context for other topic specific modules. The goal of this study was to evaluate the efficacy of this module in achieving stated learning objectives across a range of student water resources education.

We collected data from water resources students who completed assessments prior to and post completion of the Watershed UGA: Introduction to Watersheds module. These assessments were given to students in an introductory level marine sciences course for non-majors (MARS 1020), introductory level soils and water resources course (CRSS/FANR/WASR 3060) as well as students in an advanced quantitative hydrology course (WASR 4500). Module efficacy was assessed in these two courses to determine the applicability of the module to students with varying levels of water resources backgrounds. Across treatments (courses) substantial differences were observed in improvement from pre to post test for each learning objective and the overall pre and post-test.

INTRODUCTION

"What is Watershed UGA? A town & gown initiative to involve UGA campus and Athens community in restoring our streams. We are transforming these streams into a living laboratory through teaching, research, and service." – watershed.uga.edu

The Watershed UGA program is an interdisciplinary effort to improve overall water resources education and understanding of society's connection to nearby waters. An important aspect of this program is to design and implement curriculum for both science and non-science majors. Short educational modules provide a method of seamlessly incorporating these concepts as stand-alone lessons within non-science major course curricula. This is a strategy that has been effective for introducing engineering skills to k-12 students (Cantrell et al. 2006, Barrett et al 2014).

A series of educational modules have been created to address basic introductory background on watersheds through more advanced concepts such as invasive species or the role of streams in Athens' environmental history.

The *Introduction to Watersheds* module was created be used as a complete stand-alone lesson or as context for more advanced modules. Introductory concepts included in this module include: Earth's supply of freshwater, the pillars of sustainability, definition of a watershed, examples of Georgia's watersheds, human interaction with watersheds, and UGA campus watersheds. The module delivers these topics through a narrated powerpoint presentation. This allows students to guide themselves through the topics at their own pace and if needed repeat a given slide multiple times.

Introductory non-science majors are not likely to have knowledge of these concepts and should benefit greatly. Early career science majors are likely to be familiar with a few concepts but will likely not have an advanced understanding of the topic. While advanced students in water resources know many of the scientific concepts in these modules, it is possible that the social implications of watershed management have not been covered by their courses. Therefore, the goal of this study was to evaluate the efficacy of the *Introduction to Watersheds* module at achieving stated learning objectives across a range of student water resources education.

METHODS

We selected three courses that incorporated a range of student backgrounds in water resources to test the module across a range of student experience with watershed concepts. The courses we selected were an introductory science course for non-majors (MARS 1020, Introduction to the Biological Marine Evironment), introductory soils and water course (FANR/WASR 3060, Introduction to Soils and Hydrology), and an advanced hydrology course (WASR 4500, Quantitative Hydrology).

Module Learning Objectives

After viewing the *Introduction to Watersheds* module students should be able to complete the following:

- Define "watershed".
- Describe how UGA campus watersheds are part of a connected, larger system.

- Explain why it is important for UGA watersheds to be healthy.
- Identify the three pillars of sustainability.
- List the primary threats to UGA campus streams.

Learning Objective Assessment

To measure the efficacy of the module in achieving stated learning objectives we created a pre-, post- assessment for students to complete prior to using the module and after using the module. Questions directly related to each learning objective and were consistent on both the pre- and post- assessment. The assessment also included a conceptual activity where students were instructed to draw out their own idea of a watershed.

The MARS 1020 students completed the pre-module assessment just before viewing module in class and then completed the post-module assessment prior the end of class. The FANR/WASR 3060 and WASR 4500 students completed the pre-module assessment in class, and then instructed to view the narrated slide show for homework before returning to complete the post-module assessment during the following class period.

Assessment Questions

Question 1. Define a watershed.

Question 2. Identify the river that our campus streams empty into?

Question 3. List three threats to our campus streams.

Question 4. List the three pillars of sustainability.

Question 5. List three key characteristics of healthy watersheds.

Conceptual Activity: Using the space provided below, draw and label a picture of your conceptualization of watersheds. Cartoon drawings, box and arrow diagrams and concept maps are all acceptable.

RESULTS

Improvements were observed on almost all questions across classes. Pre- and post- assessment scores were generally highest in WASR 4500 (Figure 1). While MARS 1020 generally showed the lowest scores on pre-assessment, mean post assessment scores were generally close to or even with FANR 3060. MARS 1020 also demonstrated the greatest magnitudes of change between pre- and post- assessment.

Interestingly, the WASR 4500 class typically showed greater improvement between pre- and post- assessment than the FANR 3060 course despite a similar or even greater baseline from which to improve on most questions.

Mean total score was on the post assessment was 3 times higher than on the pre-assessment. Another interesting observation was that MARS 1020 course had a pre-assessment mean total score 50% lower than the FANR 3060 course, but the mean total score was the same for both courses on the post-assessment. The WASR 4500 course also started at the same pre- assessment mean total score as the FANR 3060 course but improved more after viewing the module and had a post-assessment that was double the pre-assessment score.

Interestingly, while informational content based scores generally improved substantially, mean scores on the conceptualization aspect of the assessment did not change considerably except in the MARS 1020 course where scores doubled.

DISCUSSION

The most profound improvements were in MARS 1020, an introductory science course for non-science majors. This was expected, however, the magnitude of improvement far exceeded expectations. These are very encouraging results because they indicate that we can increase water resources based environmental literacy with small science content introductions in courses for non-majors. One limitation to our results is that students completed the pre and post assessments within the same class period as viewing the module.

We acknowledge that it would have been better to have them complete the module for homework but the MARS 1020 course participation logistics would not allow this. However, we still believe our results to be indicative of the module achieving stated learning objectives because of the magnitude in improvement.

The introductory soils and water students did not improve as much as expected but this may be due to lack of module completion. More than half of students self-reported not-completing the narrated slide show between completing the pre- and post- assessment. Reasons for lack of participation are unknown and might make an interesting future avenue of research.

Our most surprising result was the improvement of the advanced hydrology students. This result was not anticipated but provides an interesting perspective moving forward with module design and implementation. We believe that these modules can be used to help advanced hydrology and water resources students fill knowledge gaps within their respective degree programs.

CONCLUSIONS

Using the module significantly improves understanding of basic introductory watershed concepts for nearly all questions across courses. Each learning objective appears to be achieved by using the module so we can conclude that the module is effective at achieving its stated learning goals. We can also conclude that the module may be useful for teaching watershed concepts in both advanced and introductory science courses. Furthermore, the module seems to be highly effective for improving the understanding of

watershed concepts for non-majors but also useful for advanced students majoring in sciences.

LITERATURE CITED

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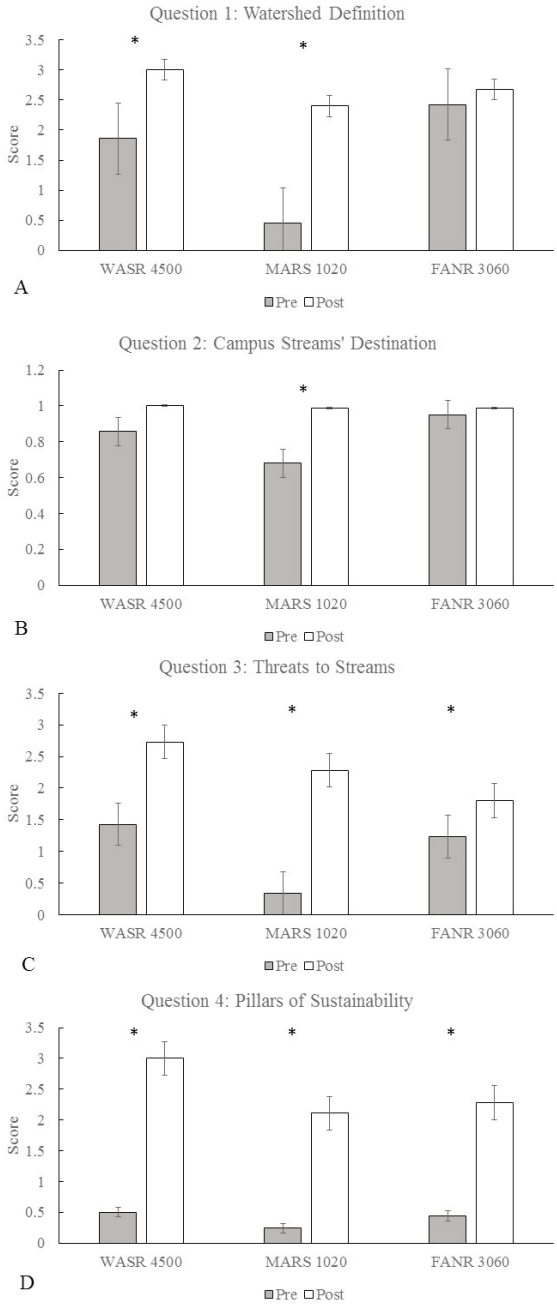

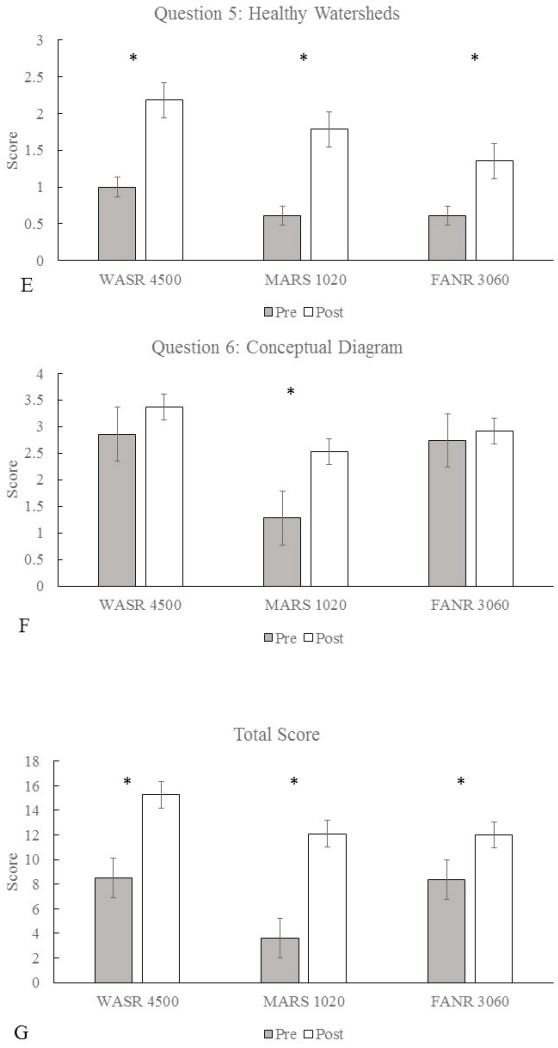

Figure 1. All courses showed a improvement in mean scores for the majority of questions. Mean score on each question improved in the advanced water resources course and introductory course for non-majors. Interestingly, less improvement was observed in the *Introduction to Water and Soils* course (FANR 3060) for science majors than the *Advanced Water Resources* course (WASR 4500) or the *Introductory Marine Sciences* course (MARS 1020).