

ONLINE QUIZZES AS A STUDY TOOL FOR BIOLOGY FOR NON-SCIENCE MAJORS

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Students of a required biology course for non-science majors were given an opportunity to take online multiple choice quizzes during the weekend interval between classes. Incentives were that they would be given extra credit for their participation. Questions from the quizzes were then placed on the next exam. After the exam was given, the number of correct answers that students gave on the quizzes was compiled relative to the number of correct responses for any question that appeared on both quiz and the exam. While it was originally envisioned that students who took the quizzes would have a great benefit over students who did not, the results did not indicate this. The students who took any of the quizzes on line, only did significantly better than their classmates on only 21 of 56 (37.5 %) of the questions that occurred on both the quiz and the exam. Similarly, only half of the students who took any of the quizzes did better on the exam than they did on the quizzes. The other result that was surprising was that only 3 (7%) took all of the quizzes while 7 (17%) of the students only took one quiz. Therefore 28 (68%) of the students in the class, took one or no quizzes during this study. This reflects the question that was asked on the first day of class "How many of you are here because you really want to learn about biology?" - deafening silence, verses "How many of you are here because this is a required course?" - noisy head nodding, raising of hands and smiling.

Introduction

In the modern age of teaching at the post K-12 level, there are many required courses that students must take in order to become well rounded citizens. These include English, humanities, mathematics and sciences. Students often must take one "life" science and one physical science. Most students who take the "non-majors" courses are there just to get through requirement rather than to become educated in the sciences. This becomes of greater interest at the Community College level. In the state of Florida, Community Colleges must admit anyone who completed a K-12 program, be it though a diploma

track or through a GED (FDOE, 2006). Therefore, the ability of the student to perform is highly varied, as is the age range (maturity) of the student. Also, there are dual enrolled students from high schools who are trying to gain college credits in their upper class years.

The dedication of many of these students for this subject matter is often questionable. Most of the students are in class because it is a requirement rather than being in the class because it is of interest to them. This lack of interest in an elementary science course leads to a teacher centered approach to the subject matter. Only as students develop a meaningful

interest can a burden of investigation shift to a more learner centered approach. While gaining some information might be beneficial for their future, most would like to do the absolute minimum in order to pass.

In today's interconnected society, students would often like to have material placed on line for their use (Gulbahar & Yildirim, 2006), while Chen et. al. (2003) cautions that too much material can be placed on line. Sanders & Morrison-Shetlar (2001) indicated that a majority of students would rather take quizzes online than on paper.

In an effort to engage students more and to have them connect more with the subject matter, Tallahassee Community College has established professional development for its full and part time faculty (TCC). The development seminars have the intention of giving the instructor more tools to use in the classroom rather than the standard learned behavior that instructors develop over the course of their career.

The objective of this study was to evaluate an outside, voluntary assignment in the form of a directed on-line quiz on the learning abilities of students in a Biology for non-science majors.

Rational for the Study

Students are constantly striving to find extra credit for grades in an attempt to obtain a higher grade. In this age of technologically oriented students (Debevec et al., 2006), it was anticipated that students would welcome the chance to participate in an on-line out-of-class exercise that would help them better their class grade.

Methodology

The class group for this study was a Biology for non-science majors class that met on Monday and Wednesday from 7 to 8:15 pm. There were 41 students in the class and ages ranged from early 20's to mid 40's.

The instructor has been teaching this class for over a decade and uses a variety of lecture methods which included chalk board, PowerPoint, and discussion. Students are permitted to ask questions at any time during the class as they feel the need for clarification. This often leads to extended discussions about class and relevant material. The instructor has a Ph.D. in a "biological science" and has been teaching since the late 70's.

Lectures were based on textbook material with other information brought in by the instructor. The other information was not placed on the quizzes or exam. Students were provided with a "study guide" of words and concepts that would be fair game on the exams. PowerPoints were based on illustration from the textbook that were provided by the publisher and other real life illustrations taken from the web.

Students were given the option of taking a quiz during the interval between the last class of the week (Wednesday) and the first class of the following week (Monday). The quizzes were available through BlackBoard from 5 pm Thursday evening through 5 pm Sunday evening. Students were permitted one attempt and the quiz needed to be completed within a 30 minute time interval. Since this time was available, it was anticipated that they would work with notes and other information.

Once taken, the feed back provided to the student was the quiz with all of the possible answers, and their answer and whether or not it was correct. The correct answer was not provided. The intent was to encourage them to find the correct answer.

The quizzes were in a multiple choice format with 5 possible answers each. Students were informed that this was an "extra-credit" assignment, and would help their grade. They were also informed that the assignment was strictly voluntary and would not be counted against them if they chose not to participate. The quizzes consisted of as few as 10 and as many as 20 multiple choice questions. Each quiz was related to the material of the previous week. The availability of each quiz was mentioned in the last class of the week.

The course was divided into 4 sections (Introductory, Genetics, Taxonomy, and Animal Systems). The first part of this was done with material relevant to taxonomy and classification of organisms (from bacteria, protists, fungi, plants and animals) while the second part was done with material relevant to animal (mostly human) systems such as the digestive, circulatory, and skeletal systems, among others.

Since half of the semester had passed when this study started, there was ample need on the part of many students for additional points for a passing grade.

Once the quizzes had been given, questions from the quizzes were then incorporated into the next exam. The students were not informed of this. The exams consisted of a total of 50 multiple choice questions with 5 possible answers each. The placement of the answers was varied

for each quiz attempt and there was no standardization between the placement of the correct answer on the quiz with the correct answer on the exam.

After the exam was given, the number of correct answers that students gave on the quizzes was compiled relative to the number of correct responses for any question that appeared on both quiz and the exam. Data collected included the number of correct answers that students got on the quiz questions, whether they obtained a correct answer for that same question on the exam, the number of correct answers that the class obtained for those questions and the total number of questions that a student answered on all quiz.

Since the exam was graded using an optical scanning method, the percent correct answer from the scan was used as the expected. Each question that appeared on a quiz was then separated out and the number of correct answers from students who took the quiz was removed from the total number of correct answers for the class. This provided an observed value for both the quiz cohort and the non-quiz cohort. Significance was tested using the Chi-squared test to determine if the quiz cohort differed from the non-quiz cohort, and to determine how each cohort did with respect to the rest of the class. Each of these comparisons were paired rather than multiple.

Results and Discussion

Part One

During the first part of the study, 3 quizzes of 10 questions each were made available. The number of students who took any of the quizzes ranged from a low

of 7 to a high of 11. A total of 15 students of the 41 enrolled in the class took one or more quizzes with 6 students taking all 3 quizzes. A scatter gram of the improvement of each student who took one or more quizzes revealed that a majority of the students who took quizzes did not improve their responses on the exam or in the case of 5 students, actually answered less questions correctly than they did on the quizzes (Figure 1).

Another consideration dealt with whether or not students would be favored by taking the quizzes, thus providing increased learning. Of the 17 questions that appeared on both the quizzes and the exams, only with 9 were there significantly different results for either quiz grade or exam grade (Table 1). With these, 4 questions (20, 12, 9 and 21) provided quiz grades that were different from the percent correct that the rest of the class received.

One of these questions (12) had less correct answers on the quiz than on the exam. Of these 9 questions, students who took the quizzes did better than the rest of the class on exam on 6 of these. Only one of these was a more difficult question (question 20, class average 30). This question asks: Continuous masses of large soft cells in the cortex of stems and roots, in the pith of stems, in leaf mesophyll and in the flesh of fruits is called? The correct answer is parenchyma. This question is normally one of the more difficult in this exam. There are 10% of the questions of this level of difficulty, in order to differentiate students who would get the highest grades. Questions like this require effort in studying in order to obtain a correct answer.

Part Two

The second part of this study dealt with topics on animal systems emphasizing

Figure 1. Scatter gram of the number of correct answers on the exam minus the number of correct answers on the quizzes for each of the students who participated in the first set of quizzes. Quiz scores are the percent correct answers that students obtained on the quizzes. The last column represents the number of quiz questions answered that appeared on exams.

| Change | Quiz Scores | Number of Quiz Questions Answered |
|--------|-------------------|-----------------------------------|
| 10 | | |
| 9 | 25 | 16 |
| 8 | | |
| 7 | | |
| 6 | 35 | 17 |
| 5 | | |
| 4 | | |
| 3 | 69 | 16 |
| 2 | 45 | 11 |
| 1 | 65 | 17 |
| 0 | 64 86 100 100 100 | 11 7 1 1 1 |
| -1 | 50 80 100 | 10 17 10 |
| -2 | 71 | 17 |
| -3 | 70 | 10 |

Table 1. Percent correct responses on 9 selected questions that were presented in a voluntary manner to students through quizzes on Blackboard, during the 4 days between classes.

| Exam Question | Class Average ^b | Quiz | Exam | Rest of Class |
|---------------|----------------------------|-------------------|-------|---------------|
| 20 | 30 | 57** ^a | 43* | 27 |
| 10 | 42 | 45 | 55* | 36 |
| 12 | 42 | 27* | 45 | 41 |
| 9 | 55 | 82** | 64 | 50 |
| 26 | 55 | 43 | 86** | 46 |
| 21 | 67 | 43** | 86* | 62 |
| 31 | 70 | 71 | 100** | 62 |
| 14 | 70 | 73 | 91* | 59 |
| 23 | 73 | 82 | 91* | 64 |

^a Numbers followed by *($p=0.05$) or **($p=0.01$) are significantly different from the class average response on the exam. Data was analyzed using the Chi square test.

^b The Class Score, and Quiz was the percent correct responses on the question either for the entire class or for those students who took the quiz. The Exam column represents the number of correct answers on the exam for those students who took the quiz and the Rest of the Class represents the percent of correct answers from those students who did not take the quiz.

these systems in humans. These topics are normally more relatable as the student had first hand knowledge of these systems before they began the course. As a result, in past years, students tend to do better on this section of the course than they do on the sections on biochemistry, genetics or classification.

During this part of the study, 3 quizzes were made available with from 10 to 20 questions each. From these 39 questions were then used on the following exam. A total of 15 students took quizzes with 3 students taking all 3 quizzes. A scatter gram of the improvement of each student who took one or more quizzes revealed that a majority of the students who took quizzes improved their responses on the exam but in the case of 1 student, actually answered less questions correctly than they did on the quizzes (Figure 2).

It appears that some of the students started using the quizzes as a directed method of studying, realizing that some of the material would then begin to appear on the exams. As such, it was not that important how well you did on the quiz but rather how the information that appeared on the quiz could interpret into a higher grade on the exam. This could be exemplified by Question 34 (relatively easy 83% class average) "Haploid cells that combine to begin the process of creating a new offspring are called:" with the correct answer being gametes. Of the 11 students that took the quiz only 5 answered correctly (45%) but on the exam, 9 students answered correctly (82%). Another example was question 22 (relatively difficult 45% class average) "The largest gland in the human body is the:" with the correct answer of the choices being the liver. The

Figure 2. Scatter gram of the number of correct answers on the exam minus the number of correct answers on the quizzes for each of the students who participated in the second set of quizzes. Quiz scores are the percent correct answers that students obtained on the quizzes. The last column represents the number of quiz questions answered that appeared on exams.

| Change | Quiz Scores | Number of Quiz Questions Answered |
|--------|--------------|-----------------------------------|
| 11 | 61 | 39 |
| 10 | | |
| 9 | 56 | 23 |
| 8 | 55 | 22 |
| 7 | 59 | 22 |
| 6 | 50 | 14 |
| 5 | 82 | 39 |
| 4 | 70 | 20 |
| 3 | | |
| 2 | 67 67 | 6 6 |
| 1 | 95 | 39 |
| 0 | 100 87 73 69 | 22 19 16 11 |
| -1 | | |
| -2 | | |
| -3 | | |
| -4 | | |
| -5 | 75 | 16 |

other choices were stomach, small intestine, kidney and large intestine. None of these words were foreign to the students. On the quiz, 40% of the students who took the quiz answered correctly, and this was not significantly different from what the rest of the class did on the exam (Table 2). However, all of the students who took that quiz answered the question correctly on the exam, and that result was significantly different from the rest of the class.

The degree of perceived difficulty by the student also appeared to have an effect on their manner of study. This is exemplified by question 33 "____ is where the organism produces living offspring without the use of a sexual act" with the correct answer being parthenogenesis. While asexual reproduction was covered in class, the term parthenogenesis was not. It was on the student study sheet. The other possible answers were sexual reproduction, fertilization, zygote and menses. All of these

terms were discussed in class. On the quiz, 8 of 11 students obtained the correct answer, indicating that some of them must have looked it up, while all of the students who took the quiz obtained the correct answer on the exam. Both of these values are significantly higher than how the rest of the class did on the exam.

While it was originally envisioned that students who took the quizzes would have a great benefit over students who did not, the results did not indicate this. The students who took any of the quizzes on line, only did significantly better than their classmates on only 21 of 56 (37.5 %) of the questions that occurred on both the quiz and the exam. Similarly, only half of the students who took any of the first quizzes did better on the exam than they did on the quizzes (5 of 10) while 10 of 15 did better on the exam than they did on the quizzes.

The other result that was surprising was

Table 2. Percent correct responses on 20 selected questions that were presented in a voluntary manner to students through quizzes on Blackboard, during the 4 days between classes.

| Exam Question | Class Average | Quiz | Exam | Rest of class |
|---------------|---------------|-------|-------|---------------|
| 41 | 41 | 60** | 60** | 37 |
| 22 | 45 | 40 | 100** | 34 |
| 25 | 45 | 80** | 80** | 38 |
| 11 | 48 | 9** | 45 | 50 |
| 33 | 52 | 73** | 100** | 23** |
| 29 | 55 | 20** | 100** | 46 |
| 19 | 62 | 60 | 100** | 54 |
| 17 | 66 | 27** | 64 | 67 |
| 13 | 69 | 100** | 80 | 67 |
| 21 | 69 | 60 | 100** | 63 |
| 38 | 69 | 100** | 100** | 63 |
| 4 | 72 | 91 | 100** | 55 |
| 28 | 72 | 40** | 100** | 66 |
| 2 | 76 | 73 | 100** | 61 |
| 12 | 76 | 55* | 82 | 72 |
| 23 | 76 | 80 | 100** | 71 |
| 35 | 76 | 45** | 100** | 61 |
| 6 | 79 | 100* | 91 | 72 |
| 40 | 79 | 100* | 100* | 75 |
| 34 | 83 | 45** | 82 | 84 |

^a Numbers followed by *($p=0.05$) or **($p=0.01$) are significantly different from the class average response on the exam. Data was analyzed using the Chi square test.

^b The Class Score, and Quiz was the percent correct responses on the question either for the entire class or for those students who took the quiz. The Exam column represents the number of correct answers on the exam for those students who took the quiz and the Rest of the Class represents the percent of correct answers from those students who did not take the quiz.

that only 20 students participated in the online quizzes. Of these only 3 (7%) took all of the quizzes while 7 (17%) of the students only took one quiz. Therefore 28 (68%) of the students in the class, took one or no quizzes during this study. This reflects the question that was asked on the first day of class "How many of you are here because you really want to learn about biology?" - deafening silence, verses "How many of you are here because this is a required course?" - noisy head nodding, raising of hands and smiling.

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